Service Manual

Models
G5-18A & 2505H

Agrovector
25.5

S/N 0160053000 & After including
0160051045, 0160051047, 0160051049,
0160051194 & 0160051359

31200926

Revised
January 8, 2015

An Oshkosh Corporation Company

EFFECTIVITY PAGE

May 9, 2013 - A - Original Issue Of Manual

January 8, 2015 - B - Revise Pages 1-4, 2-2 thru 2-12, 2-16, 2-17, 7-2.

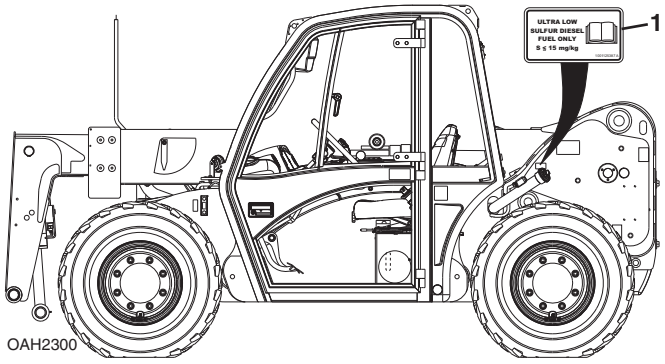
Modifications

Modifications to this machine may affect compliance with Industry Standards and/or Governmental Regulations. Any modification must be approved by JLG.

Machine Configuration

Two configurations of each machine are included in this manual. Determine if machine is equipped with Ultra Low Sulfur Fuel Decal (**1**) as indicated below.

- If equipped with the Ultra Low Sulfur decal, all specific references to this machine configuration will be referred to as Ultra Low Sulfur (**ULS**) from this point forward.
- If **not** equipped with the Ultra Low Sulfur decal, all specific references to this machine configuration will be referred to as Low Sulfur (**LS**) from this point forward.



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Safety Practices

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1.1 INTRODUCTION

This service manual provides general directions for accomplishing service and repair procedures. Following the procedures in this manual will help assure safety and equipment reliability.

Read, understand and follow the information in this manual, and obey all locally approved safety practices, procedures, rules, codes, regulations and laws.

These instructions cannot cover all details or variations in the equipment, procedures, or processes described, nor provide directions for meeting every possible contingency during operation, maintenance, or testing. When additional information is desired consult the local **JLG** Dealer.

Many factors contribute to unsafe conditions: carelessness, fatigue, overload, inattentiveness, unfamiliarity, even drugs and alcohol, among others. For optimal safety, encourage everyone to think, and to act, safely.

Appropriate service methods and proper repair procedures are essential for the safety of the individual doing the work, for the safety of the operator, and for the safe, reliable operation of the machine. All references to the right side, left side, front and rear are given from the operator's seat looking in a forward direction.

Supplementary information is available from **JLG** in the form of Service Bulletins, Service Campaigns, Service Training Schools, the **JLG** website, other literature and through updates to the manual itself.

1.2 DISCLAIMER

All information in this manual is based on the latest product information available at the time of publication. **JLG** reserves the right to make changes and improvements to its products, and to discontinue the manufacture of any product, at its discretion at any time without public notice or obligation.

1.3 OPERATION & SAFETY MANUAL

The mechanic must not operate the machine until the Operation & Safety Manual has been read and understood, training has been accomplished and operation of the machine has been completed under the supervision of an experienced and qualified operator.

An Operation & Safety Manual is supplied with each machine and must be kept in the manual holder located in the cab. In the event that the Operation & Safety Manual is missing, consult the local **JLG** Dealer before proceeding.

1.4 DO NOT OPERATE TAGS

Place Do Not Operate Tags on the ignition key switch and the steering wheel before attempting to perform any service or maintenance. Remove key and disconnect battery leads.

1.5 SAFETY INFORMATION

To avoid possible death or injury, carefully read, understand and comply with all safety messages.

In the event of an accident, know where to obtain medical assistance and how to use a first-aid kit and fire extinguisher/fire suppression system. Keep emergency telephone numbers (fire department, ambulance, rescue squad/paramedics, police department, etc.) nearby. If working alone, check with another person routinely to help assure personal safety.

1.5.1 Safety Alert System and Signal Words

DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

1.6 SAFETY INSTRUCTIONS

Following are general safety statements to consider ***BEFORE*** performing maintenance procedures on the telehandler. Additional statements related to specific tasks and procedures are located throughout this manual and are listed prior to any work instructions to provide safety information before the potential of a hazard occurs.

For all safety messages, carefully read, understand and follow the instructions ***BEFORE*** proceeding.

1.6.1 Personal Hazards

PERSONAL SAFETY GEAR: Wear all the protective clothing and personal safety gear necessary to perform the job safely. This might include heavy gloves, safety glasses or goggles, filter mask or respirator, safety shoes or a hard hat.

LIFTING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist.

1.6.2 Equipment Hazards

LIFTING OF EQUIPMENT: Before using any lifting equipment (chains, slings, brackets, hooks, etc.), verify that it is of the proper capacity, in good working order, and is properly attached.

NEVER stand or otherwise become positioned under a suspended load or under raised equipment. The load or equipment could fall or tip.

DO NOT use a hoist, jack or jack stands only to support equipment. Always support equipment with the proper capacity blocks or stands properly rated for the load.

HAND TOOLS: Always use the proper tool for the job; keep tools clean and in good working order, and use special service tools only as recommended.

1.6.3 General Hazards

SOLVENTS: Only use approved solvents that are known to be safe for use.

HOUSEKEEPING: Keep the work area and operator's cab clean, and remove all hazards (debris, oil, tools, etc.).

FIRST AID: Immediately clean, dress and report all injuries (cuts, abrasions, burns, etc.), no matter how minor the injury may seem. Know the location of a First Aid Kit, and know how to use it.

CLEANLINESS: Wear eye protection and clean all components with a high-pressure or steam cleaner before attempting service.

When removing hydraulic components, plug hose ends and connections to prevent excess leakage and contamination. Place a suitable catch basin beneath the machine to capture fluid run-off.

It is good practice to avoid pressure-washing electrical/ electronic components. In the event pressure-washing the machine is needed, ensure machine is shut down before pressure-washing. Should pressure-washing be utilized to wash areas containing electrical/electronic components, it is recommended a maximum pressure of 750 psi (52 bar) at a minimum distance of 12 in (30,5 cm) away from these components. If electrical/electronic components are sprayed, spraying must not be direct and for brief time periods to avoid heavy saturation,

Check and obey all Federal, State and/or Local regulations regarding waste storage, disposal and recycling.

1.6.4 Operational Hazards

ENGINE: Stop the engine before performing any service unless specifically instructed otherwise.

VENTILATION: Avoid prolonged engine operation in enclosed areas without adequate ventilation.

SOFT SURFACES AND SLOPES: **NEVER** work on a machine that is parked on a soft surface or slope. The machine must be on a hard level surface, with the wheels blocked before performing any service.

FLUID TEMPERATURE: NEVER work on a machine when engine, cooling or hydraulic systems are hot. Hot components and fluids can cause severe burns. Allow systems to cool before proceeding.

FLUID PRESSURE: Before loosening any hydraulic or diesel fuel component, hose or tube, turn the engine OFF. Wear heavy, protective gloves and eye protection. **NEVER** check for leaks using any part of your body; use a piece of cardboard or wood instead. If injured, seek medical attention immediately. Diesel fluid leaking under pressure can explode. Hydraulic fluid and diesel fuel leaking under pressure can penetrate the skin, cause infection, gangrene and other serious personal injury.

Engine fuel lines are pressurized. **DO NOT** attempt repairs unless specific training has been completed. Refer to the engine manufacturers' manual for specific details concerning the fuel system.

Relieve all pressure before disconnecting any component, part, line or hose. Slowly loosen parts and allow release of residual pressure before removing any part or component. Before starting the engine or applying pressure, use components, parts, hoses and pipes that are in good condition, connected properly and are tightened to the proper torque. Capture fluid in an appropriate container and dispose of in accordance with prevailing environmental regulations.

COOLANT SYSTEM CAP: The cooling system is under pressure, and escaping coolant can cause severe burns and eye injury. To prevent personal injury, NEVER remove the coolant system cap while the cooling system is hot. Wear safety glasses. Turn the coolant system cap to allow pressure to escape before removing the cap completely. Failure to follow the safety practices could result in death or serious injury.

FLUID FLAMABILTITY: **DO NOT** service the fuel or hydraulic systems near an open flame, sparks or smoking materials.

Properly disconnect battery prior to servicing the fuel or hydraulic systems.

NEVER drain or store fluids in an open container. Engine fuel and hydraulic fluid are flammable and can cause a fire and/or explosion.

DO NOT mix gasoline or alcohol with diesel fuel. The mixture can cause an explosion.

PRESSURE TESTING: When conducting any test, only use test equipment that is correctly calibrated and in good condition. Use the correct equipment in the proper manner, and make changes or repairs as indicated by the test procedure to achieve the desired result.

LEAVING MACHINE: Lower the forks or attachment to the ground before leaving the machine.

TIRES: Always keep tires inflated to the proper pressure to help prevent tipover. **DO NOT** over-inflate tires.

NEVER use mismatched tire types, sizes or ply ratings. Always use matched sets according to machine specifications.

MAJOR COMPONENTS: Never alter, remove, or substitute any items such as counterweights, tires, batteries or other items that may reduce or affect the overall weight or stability of the machine.

BATTERY: DO NOT charge a frozen battery.Charging a frozen battery may cause it to explode. Allow the battery to thaw before jump-starting or connecting a battery charger.

1.7 SAFETY DECALS

Check that all safety decals are present and readable on the machine. Refer to the Operation & Safety Manual supplied with machine for information.

Section 2
General Information and Specifications

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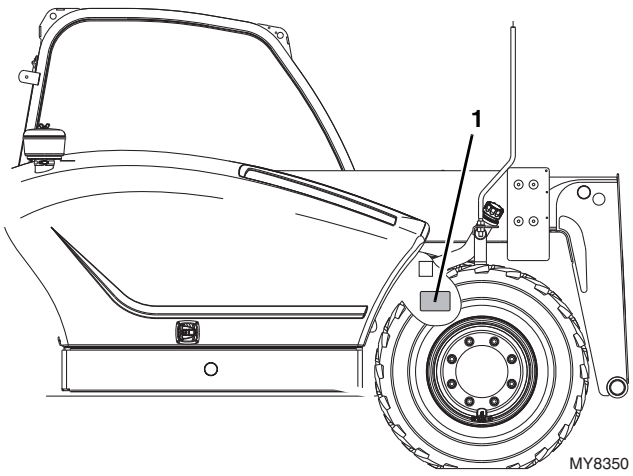
2.1 REPLACEMENT PARTS AND WARRANTY INFORMATION



Before ordering parts or initiating service inquiries, make note of the machine serial number. The machine serial number plate (**1**) is located as indicated in the figure.

Note: *The replacement of any part on this machine with any other than **JLG** authorized replacement parts can adversely affect the performance, durability, or safety of the machine, and will void the warranty. **JLG** disclaims liability for any claims or damages, whether regarding property damage, personal injury or death arising out of the use of unauthorized replacement parts.*

A warranty registration form must be filled out by the **JLG** Dealer.

Registration activates the warranty period and helps to assure that warranty claims are promptly processed to guarantee full warranty service.

2.2 THREAD LOCKING COMPOUND

JLG P/N	Loctite®	ND Industries	Description
0100011	242™	Vibra-TITE™121	Medium Strength (Blue)
1001095650	243™	Vibra-TITE™122	Medium Strength (Blue)
0100019	271™	Vibra-TITE™140	High Strength (Red)
0100071	262™	Vibra-TITE™131	Medium - High Strength (Red)

Loctite® 243™ can be substituted in place of Loctite® 242™. Vibra-TITE™ 122 can be substituted in place of Vibra-TITE™ 121.

2.3 TORQUE CHARTS

2.3.1 SAE Fastener Torque Chart

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)												
SAE GRADE 5 BOLTS & GRADE 2 NUTS												
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry)		Torque Lubricated		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140)		Torque (Loctite® 262™ or Vibra-TITE™ 131)	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	8	0.9	6	0.7				
	48	0.1120	0.00661	420	9	1.0	7	0.8				
6	32	0.1380	0.00909	580	16	1.8	12	1.4				
	40	0.1380	0.01015	610	18	2.0	13	1.5				
8	32	0.1640	0.01400	900	30	3.4	22	2.5				
	36	0.1640	0.01474	940	31	3.5	23	2.6				
10	24	0.1900	0.01750	1120	43	4.8	32	3.5				
	32	0.1900	0.02000	1285	49	5.5	36	4				
1/4	20	0.2500	0.0318	2020	96	10.8	75	9	105	12		
	28	0.2500	0.0364	2320	120	13.5	86	10	135	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	17	23	13	18	19	26	16	22
	24	0.3125	0.0580	3700	19	26	14	19	21	29	17	23
3/8	16	0.3750	0.0775	4940	30	41	23	31	35	48	28	38
	24	0.3750	0.0878	5600	35	47	25	34	40	54	32	43
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	75	45	61
	20	0.4375	0.1187	7550	55	75	40	54	60	82	50	68
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	116	68	92
	20	0.5000	0.1599	10700	90	122	65	88	100	136	80	108
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	163	98	133
	18	0.5625	0.2030	12950	120	163	90	122	135	184	109	148
5/8	11	0.6250	0.2260	14400	150	203	110	149	165	224	135	183
	18	0.6250	0.2560	16300	170	230	130	176	190	258	153	207
3/4	10	0.7500	0.3340	21300	260	353	200	271	285	388	240	325
	16	0.7500	0.3730	23800	300	407	220	298	330	449	268	363
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	646	386	523
	14	0.8750	0.5090	32400	470	637	350	475	520	707	425	576
1	8	1.0000	0.6060	38600	640	868	480	651	675	918	579	785
	12	1.0000	0.6630	42200	700	949	530	719	735	1000	633	858
1 1/8	7	1.1250	0.7630	42300	800	1085	600	813	840	1142	714	968
	12	1.1250	0.8560	47500	880	1193	660	895	925	1258	802	1087
1 1/4	7	1.2500	0.9690	53800	1120	1518	840	1139	1175	1598	1009	1368
	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1768	1118	1516
1 3/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	2074	1322	1792
	12	1.3750	1.3150	73000	1680	2278	1260	1708	1750	2380	1506	2042
1 1/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	2754	1755	2379
	12	1.5000	1.5800	87700	2200	2983	1640	2224	2300	3128	1974	2676

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

2.3.1 SAE Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.20		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474	1320	43	5				
10	24	0.1900	0.01750	1580	60	7				
	32	0.1900	0.02000	1800	68	8				
1/4	20	0.2500	0.0318	2860	143	16	129	15		
	28	0.2500	0.0364	3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	25	35	20	25	20	25
	24	0.3125	0.0580	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	7000	45	60	40	55	35	50
	24	0.3750	0.0878	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	9550	70	95	65	90	50	70
	20	0.4375	0.1187	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	12750	105	145	95	130	80	110
	20	0.5000	0.1599	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	16400	155	210	140	190	115	155
	18	0.5625	0.2030	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	20350	210	285	190	260	160	220
	18	0.6250	0.2560	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	30100	375	510	340	460	280	380
	16	0.7500	0.3730	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	41600	605	825	545	740	455	620
	14	0.8750	0.5090	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	51500	860	1170	770	1045	645	875
	12	1.0000	0.6630	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	142200	3555	4835	3200	4350	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

2.3.1 SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 5 BOLTS & GRADE 2 NUTS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	7	0.8				
	48	0.1120	0.00661	420	8	0.9				
6	32	0.1380	0.00909	580	14	1.5				
	40	0.1380	0.01015	610	14	1.6				
8	32	0.1640	0.01400	900	25	2.8				
	36	0.1640	0.01474	940	26	2.9				
10	24	0.1900	0.01750	1120	36	4.1				
	32	0.1900	0.02000	1285	42	4.7				
1/4	20	0.2500	0.0318	2020	86	9.7	80	9		
	28	0.2500	0.0364	2320	99	11.1	95	11		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	15	20	14	19	15	20
	24	0.3125	0.0580	3700	15	20	15	21	15	20
3/8	16	0.3750	0.0775	4940	25	35	25	34	25	34
	24	0.3750	0.0878	5600	30	40	28	38	25	34
7/16	14	0.4375	0.1063	6800	40	55	40	54	35	48
	20	0.4375	0.1187	7550	45	60	44	60	40	54
1/2	13	0.5000	0.1419	9050	65	90	60	82	55	75
	20	0.5000	0.1599	10700	75	100	71	97	65	88
9/16	12	0.5625	0.1820	11600	90	120	87	118	80	109
	18	0.5625	0.2030	12950	105	145	97	132	90	122
5/8	11	0.6250	0.2260	14400	130	175	120	163	115	156
	18	0.6250	0.2560	16300	145	195	136	185	125	170
3/4	10	0.7500	0.3340	21300	225	305	213	290	200	272
	16	0.7500	0.3730	23800	255	345	238	324	225	306
7/8	9	0.8750	0.4620	29400	365	495	343	466	320	435
	14	0.8750	0.5090	32400	400	545	378	514	355	483
1	8	1.0000	0.6060	38600	545	740	515	700	480	653
	12	1.0000	0.6630	42200	600	815	563	765	530	721
1 1/8	7	1.1250	0.7630	42300	675	920	635	863	595	809
	12	1.1250	0.8560	47500	755	1025	713	969	670	911
1 1/4	7	1.2500	0.9690	53800	955	1300	897	1219	840	1142
	12	1.2500	1.0730	59600	1055	1435	993	1351	930	1265
1 3/8	6	1.3750	1.1550	64100	1250	1700	1175	1598	1100	1496
	12	1.3750	1.3150	73000	1420	1930	1338	1820	1255	1707
1 1/2	6	1.5000	1.4050	78000	1660	2260	1560	2122	1465	1992
	12	1.5000	1.5800	87700	1865	2535	1754	2385	1645	2237

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

2.3.1 SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474	1320	37	4				
10	24	0.1900	0.01750	1580	51	6				
	32	0.1900	0.02000	1800	58	7				
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	410	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

2.3.1 SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SOCKET HEAD CAP SCREWS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) or Precoat® 85 K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	415	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

2.3.1 SAE Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*										
SOCKET HEAD CAP SCREWS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) or Precoat® 85 K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	415	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

2.3.2 Metric Fastener Torque Chart

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*							
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS							
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™)	Torque (Lub)	Torque (Loctite® 262™ or 271™ or Vibra-TITE™ 131)	Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 141)
		Sq mm	KN	[N.m]		[N.m]	[N.m]
3	0.5	5.03	2.19	1.3	1.0	1.2	1.4
3.5	0.6	6.78	2.95	2.1	1.6	1.9	2.3
4	0.7	8.78	3.82	3.1	2.3	2.8	3.4
5	0.8	14.20	6.18	6.2	4.6	5.6	6.8
6	1	20.10	8.74	11	7.9	9.4	12
7	1	28.90	12.6	18	13	16	19
8	1.25	36.60	15.9	26	19	23	28
10	1.5	58.00	25.2	50	38	45	55
12	1.75	84.30	36.7	88	66	79	97
14	2	115	50.0	140	105	126	154
16	2	157	68.3	219	164	197	241
18	2.5	192	83.5	301	226	271	331
20	2.5	245	106.5	426	320	383	469
22	2.5	303	132.0	581	436	523	639
24	3	353	153.5	737	553	663	811
27	3	459	199.5	1080	810	970	1130
30	3.5	561	244.0	1460	1100	1320	1530
33	3.5	694	302.0	1990	1490	1790	2090
36	4	817	355.5	2560	1920	2300	2690
42	4.5	1120	487.0	4090	3070	3680	4290

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

2.3.2 Metric Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*						
CLASS 10.9 METRIC (HEX HEAD) BOLTS, CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAP SCREWS M3 - M5*						
Size	**Pitch**	**Tensile Stress Area**	**Clamp Load See Note 4**	**Torque (Dry or Loctite® 263™) K=0.20**	**Torque (Lub or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18**	**Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15**
		Sq mm	**KN**	**[N.m]**	**[N.m]**	**[N.m]**
3	0.5	5.03	3.13			
3.5	0.6	6.78	4.22			
4	0.7	8.78	5.47			
5	0.8	14.20	8.85			
6	1	20.10	12.5			
7	1	28.90	18.0	25	23	19
8	1.25	36.60	22.8	37	33	27
10	1.5	58.00	36.1	70	65	55
12	1.75	84.30	52.5	125	115	95
14	2	115	71.6	200	180	150
16	2	157	97.8	315	280	235
18	2.5	192	119.5	430	385	325
20	2.5	245	152.5	610	550	460
22	2.5	303	189.0	830	750	625
24	3	353	222.0	1065	960	800
27	3	459	286.0	1545	1390	1160
30	3.5	561	349.5	2095	1885	1575
33	3.5	694	432.5	2855	2570	2140
36	4	817	509.0	3665	3300	2750
42	4.5	1120	698.0	5865	5275	4395

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

2.3.2 Metric Fastener Torque Chart (Continued)

Values for Magni Coated Fasteners (Ref 4150701)*						
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS						
Size	**Pitch**	**Tensile Stress Area**	**Clamp Load See Note 4**	**Torque (Dry or Loctite® 263™) K=0.17**	**Torque (Lub or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16**	**Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15**
		Sq mm	**KN**	**[N.m]**	**[N.m]**	**[N.m]**
3	0.5	5.03	2.19	1.1	1.1	1.0
3.5	0.6	6.78	2.95	1.8	1.7	1.5
4	0.7	8.78	3.82	2.6	2.4	2.3
5	0.8	14.20	6.18	5.3	4.9	4.6
6	1	20.10	8.74	9	8.4	7.9
7	1	28.90	12.6	15	14	13
8	1.25	36.60	15.9	22	20	19
10	1.5	58.00	25.2	43	40	38
12	1.75	84.30	36.7	75	70	66
14	2	115	50.0	119	110	105
16	2	157	68.3	186	175	165
18	2.5	192	83.5	256	240	225
20	2.5	245	106.5	362	340	320
22	2.5	303	132.0	494	465	435
24	3	353	153.5	627	590	555
27	3	459	199.5	916	860	810
30	3.5	561	244.0	1245	1170	1100
33	3.5	694	302.0	1694	1595	1495
36	4	817	355.5	2176	2050	1920
42	4.5	1120	487.0	3477	3275	3070

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

2.3.2 Metric Fastener Torque Chart (Continued)

Values for Magni Coated Fasteners (Ref 4150701)*						
CLASS 10.9 METRIC (HEX HEAD) BOLTS CLASS 10 METRIC NUTS, CLASS 12.9 SOCKET HEAD CAP SCREWS M6 AND ABOVE*						
Size	**Pitch**	**Tensile Stress Area**	**Clamp Load See Note 4**	**Torque (Dry or Loctite® 263™) K=0.17**	**Torque (Lub or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18**	**Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15**
		Sq mm	**KN**	**[N.m]**	**[N.m]**	**[N.m]**
3	0.5	5.03	3.13			
3.5	0.6	6.78	4.22			
4	0.7	8.78	5.47			
5	0.8	14.20	8.85			
6	1	20.10	12.5	13	12	11
7	1	28.90	18.0	21	20	19
8	1.25	36.60	22.8	31	29	27
10	1.5	58.00	36.1	61	58	55
12	1.75	84.30	52.5	105	100	95
14	2	115	71.6	170	160	150
16	2	157	97.8	265	250	235
18	2.5	192	119.5	365	345	325
20	2.5	245	152.5	520	490	460
22	2.5	303	189.0	705	665	625
24	3	353	222.0	905	850	800
27	3	459	286.0	1315	1235	1160
30	3.5	561	349.5	1780	1680	1575
33	3.5	694	432.5	2425	2285	2140
36	4	817	509.0	3115	2930	2750
42	4.5	1120	698.0	4985	4690	4395

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

2.3.3 Hydraulic Hose Torque Chart

O-Ring Face Seal & JIC Torque Chart			
Size	**ORFS**	**JIC**	**Flats Method**
4	13 lb-ft (18 Nm)	13 lb-ft (18 Nm)	1.5 to 1.75
6	23 lb-ft (31 Nm)	23 lb-ft (31 Nm)	1 to 1.5
8	40 lb-ft (54 Nm)	40 lb-ft (54 Nm)	1.5 to 1.75
10	60 lb-ft (81 Nm)	60 lb-ft (81 Nm)	1.5 to 1.75
12	136 lb-ft (100 Nm)	136 lb-ft (100 Nm)	1.0 to 1.5
16	115 lb-ft (156 Nm)	115 lb-ft (156 Nm)	0.75 to 1.0
20	170 lb-ft (230 Nm)	170 lb-ft (230 Nm)	0.75 to 1.0
24	200 lb-ft (271 Nm)	200 lb-ft (271 Nm)	0.75 to 1.0
32	N/A	270 lb-ft (366 Nm)	0.75 to 1.0

Note: *By definition the "Flats Method" will contain some variance. Use the "Flats Method" only when accessibility with a torque wrench is not possible.*

Torque Wrench:

1. Identify the appropriate application and refer to the above chart for the correct torque value.
2. If equipped, lubricate o-ring with hydraulic oil. Hand tighten the swivel nut until no lateral movement of the swivel nut can be detected. Average hand torque is 3 lb-ft (4 Nm).
3. Use the double wrench method while tightening to avoid hose twist.
4. Torque wrench must be held at the center of the grip. Apply constant force until it clicks.
5. After connection has been properly tightened, mark a straight line across connecting parts indicating that connection has been properly tightened.

Flats Method:

1. If equipped, lubricate o-ring with hydraulic oil. Hand tighten the swivel nut until no lateral movement of the swivel nut can be detected. Average hand torque is 3 lb-ft (4 Nm).
2. Mark a dot on one of swivel nut flats and another dot in line on hex of adapter it's connecting to.
3. Use double wrench method while tightening to avoid hose twist.
4. After connection has been properly tightened, mark a straight line across the connecting parts, not covering dots indicating that connection has been properly tightened.

2.4 SPECIFICATIONS

2.4.1 Travel Speed

Tires	Approximate Speed
12–16.50 (305/70D16.5)	15 mph (24 km/h)
14–17.50 (355/70D17.5)	17 mph (27 km/h)
10.5–18	17 mph (27 km/h)

2.4.2 Hydraulic Cylinder Performance Specifications

Note: *Machine with no load, engine at full throttle, hydraulic oil above 15.6° C (60° F) minimum, engine at operating temperature.*

Function	Approximate Times (sec.)	
	ANSI	CE & AUS
Boom Extend (Boom Level)	6.7	6.7
Boom Retract	3.8	3.5
Boom Lift	6.8	6.6
Boom Lower	4.6	8.2
Quick Attach—UP	2.0	1.8
Quick Attach—DOWN	2.5	2.3

2.4.3 Electrical System

Note: *Refer to Section 9.3, "Fuses and Relays," for more information.*

Battery	
Type, Rating	12 BCI, Negative (-) Ground, Maintenance Free
Cold Cranking Amps @ 0° F (-18° C)	950
Cranking Amps @ 32° F (-18° C)	1190
Reserve Capacity Minutes @ 25 Amps	185
Group/Series	Group 31
Alternator	14V, 95 Amps

2.4.4 Engine Performance Specifications

Description	
Engine Make/Model	Deutz TD L4
Displacement	177 in^3 (2.9 L)
Low Idle	975 - 1075 rpm
High Idle	2300 - 2400 rpm
Horsepower	74 HP (55 kW) @ 2300 rpm
Peak Torque	192 lb-ft (260 Nm) @ 1800 rpm
Fuel Delivery	Fuel Injection
Air Cleaner	Dry Type, Replaceable Primary and Safety Elements

2.4.5 Tires

Note: *Standard wheel lug nut torque is 220 lb-ft (300 Nm).*

Note: *Pressures for Foam filled tires are for initial fill ONLY.*

Size	Tire Type	Minimum Ply/ Star Rating	Fill Type	Pressure
12–16.50 (305/70D16.5)	Duraforce DT	Bias 12 Ply	Pneumatic	80 psi (5,5 bar)
			Foam - Approximately 220 lb (100 kg)	
14–17.50 (355/70D17.5)	Outrigger	Bias 14 Ply	Pneumatic	70 psi (4,8 bar)
			Foam - Approximately 220 lb (100 kg)	
10.5–18	MPT-01 TL	Bias 16 Ply	Pneumatic	87 psi (6,0 bar)
33x12–20	Non–Marking (White)			

2.5 FLUIDS, LUBRICANTS AND CAPACITIES

2.5.1 Fluids

a. If Equipped for ULS

Compartment or System	Type and Classification	Viscosities	Ambient Temperature Range			
			°F		°C	
			Min	Max	Min	Max
Engine Crankcase	API CJ-4 Plus	SAE 0W-30	-20	0	-29	-18
		SAE 5W-30	-15	70	-26	21
		SAE 10W-30	-9	70	-22	21
		SAE 15W-40	5	120	-15	49
Axle Differential and Wheel End	MobilFluid 424	10W-30	0	104	-20	40
	MobilFluid LT	75W-80	-40	0	-40	-20
	API GL-4 with LS Additives or API GL5 with LS Additives	SAE 140	50	122	10	50
		80W-140 85W-140	14	122	-10	50
		SAE90 SAE90LS	32	104	0	40
		80W-90 85W-90	-4	104	-20	40
		75W-90	-40	104	-20	40
		75W	-40	50	-40	10
Hydraulic System	MobilFluid 424	10W-30	0	104	-20	40
	Exxon Univis HVI 26		-40	0	-40	20
Brake System	MobilFluid 424	10W-30	15	120	-10	49
Boom Wear Pad Grease	Mystik Tetrimoly	NLGI Grade 2	-4	104	-20	40
Cylinder and Axle Grease	Multipurpose Grease	NLGI Grade 2	-22	104	-30	40
Boom Chain Lubricant	Schaffer 200S Silver Streak					
Engine Coolant	Ethylene Glycol and Water	50/50 Mix	Standard			
		60/40 Mix	Cold Weather			
Fuel	#2 Diesel	Ultra Low Sulfur (S ≤ 15 mg/kg)	Standard			
	B5 Biodiesel fuels					
	Blend of #1 diesel and #2 diesel fuels ("winterized" #2)		Cold Weather			
	B5 Biodiesel with Winter Conditioner					
Air Conditioning	Refrigerant R-134-a	Tetrafluoroethane				

Note: *Friction Modifier may be added to front axle differentials, refer to Section 2.5.2, "Capacities."*

b. If Equipped for LS

Compartment or System	Type and Classification	Viscosities	Ambient Temperature Range			
			° F		° C	
			Min	Max	Min	Max
Engine Crankcase	API CI-4 Plus	SAE 0W-30	-20	0	-29	-18
		SAE 5W-30	-15	70	-26	21
		SAE 10W-30	-9	70	-22	21
		SAE 15W-40	5	120	-15	49
Axle Differential and Wheel End	MobilFluid 424	10W-30	0	104	-20	40
	MobilFluid LT	75W-80	-40	0	-40	-20
	API GL-4 with LS Additives or API GL5 with LS Additives	SAE 140	50	122	10	50
		80W-140 85W-140	14	122	-10	50
		SAE90 SAE90LS	32	104	0	40
		80W-90 85W-90	-4	104	-20	40
		75W-90	-40	104	-20	40
		75W	-40	50	-40	10
Hydraulic System	MobilFluid 424	10W-30	0	104	-20	40
	Exxon Univis HVI 26		-40	0	-40	20
Brake System	MobilFluid 424	10W-30	15	120	-10	49
Boom Wear Pad Grease	Mystik Tetrimoly	NLGI Grade 2	-4	104	-20	40
Cylinder and Axle Grease	Multipurpose Grease	NLGI Grade 2	-22	104	-30	40
Boom Chain Lubricant	Schaffer 200S Silver Streak					
Engine Coolant	Ethylene Glycol and Water	50/50 Mix	Standard			
		60/40 Mix	Cold Weather			
Fuel	#2 Diesel	Low Sulfur (S ≤ 500 mg/kg)	Standard			
	B5 Biodiesel fuels					
	Blend of #1 diesel and #2 diesel fuels ("winterized" #2)		Cold Weather			
	B5 Biodiesel with Winter Conditioner					
Air Conditioning	Refrigerant R-134-a	Tetrafluoroethane				

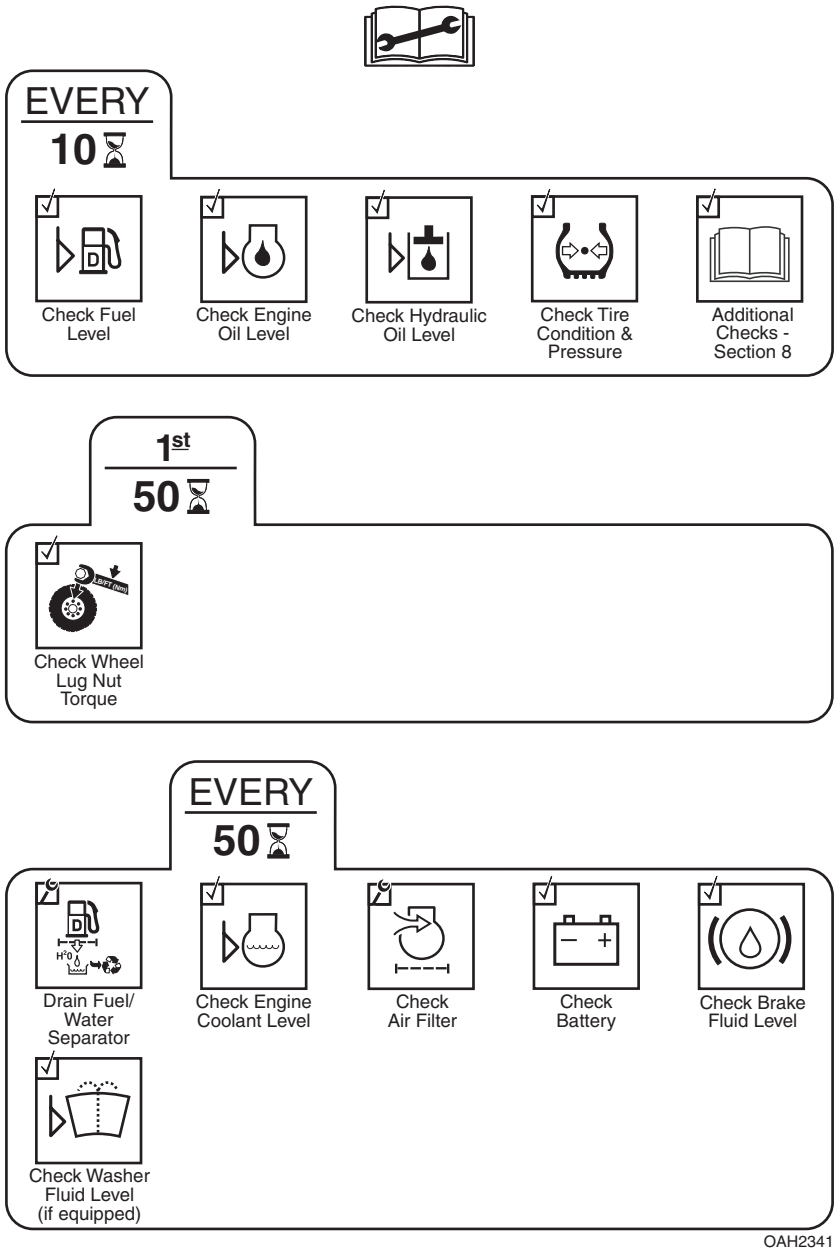
Note: *Friction Modifier may be added to front axle differentials, refer to Section 2.5.2, "Capacities."*

2.5.2 Capacities

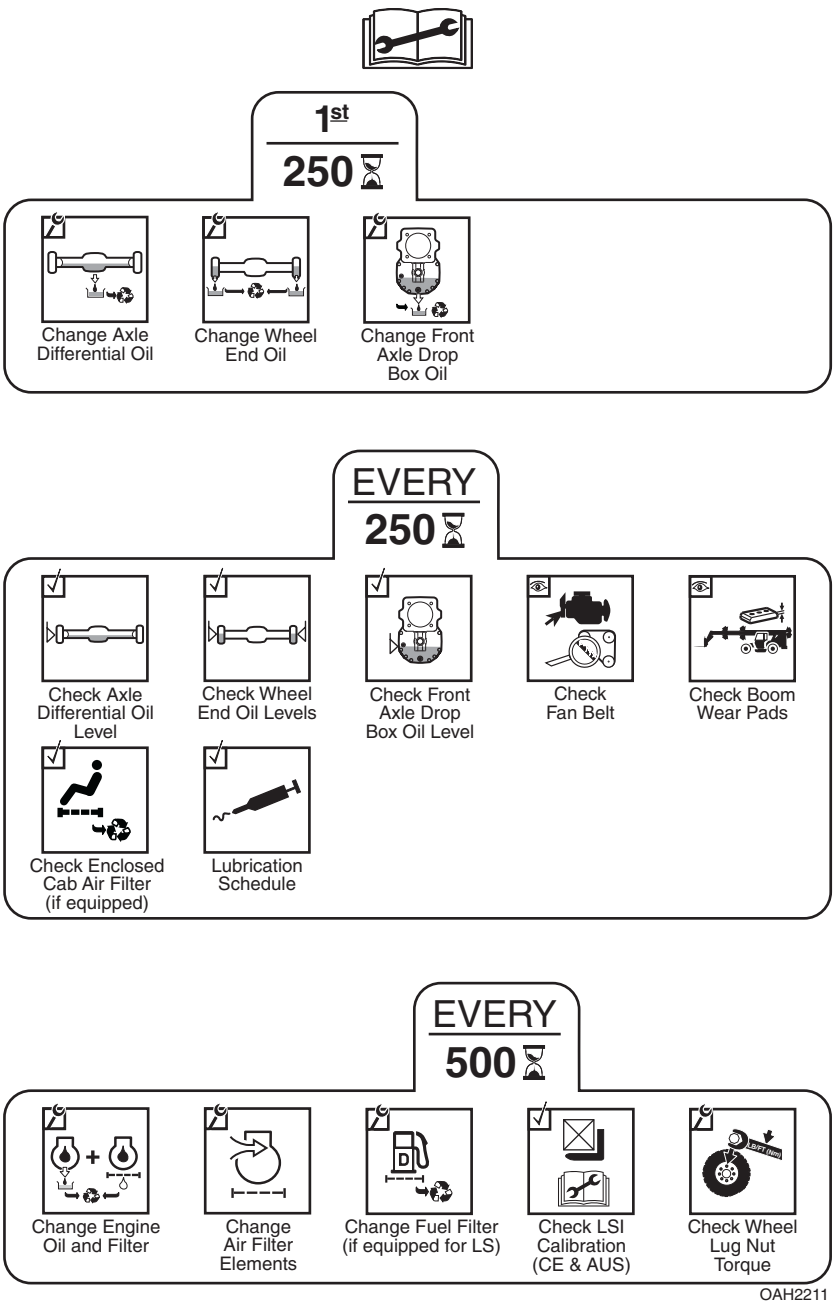
Engine Crankcase Oil	
Capacity w/Filter Change	9.6 qt (9,1 L)
Fuel Tank	
Capacity	24 gal (91 L)
Cooling System	
System Capacity	14 qt (13,2 L)
Hydraulic System	
System Capacity	24 gal (91 L)
Reservoir Capacity to Full Mark	16 gal (61 L)
Auxiliary Hydraulic Circuit Max Flow	18.7 gpm (71 lpm)
Brake System	
System Capacity	0.7 qt (0,7 L)
Axles	
Differential Housing Capacity	3.5 qt (3,3 L)
Friction Modifier (Front Axle Only)	5.4 oz (0,16 L)
Wheel End Capacity	24 oz (0,7 L)
Front Axle Drop Box	21 oz (0,6 L)
Air Conditioning System (if equipped)	
System Capacity	1.7 lb (771 g)

2.6 MAINTENANCE SCHEDULE

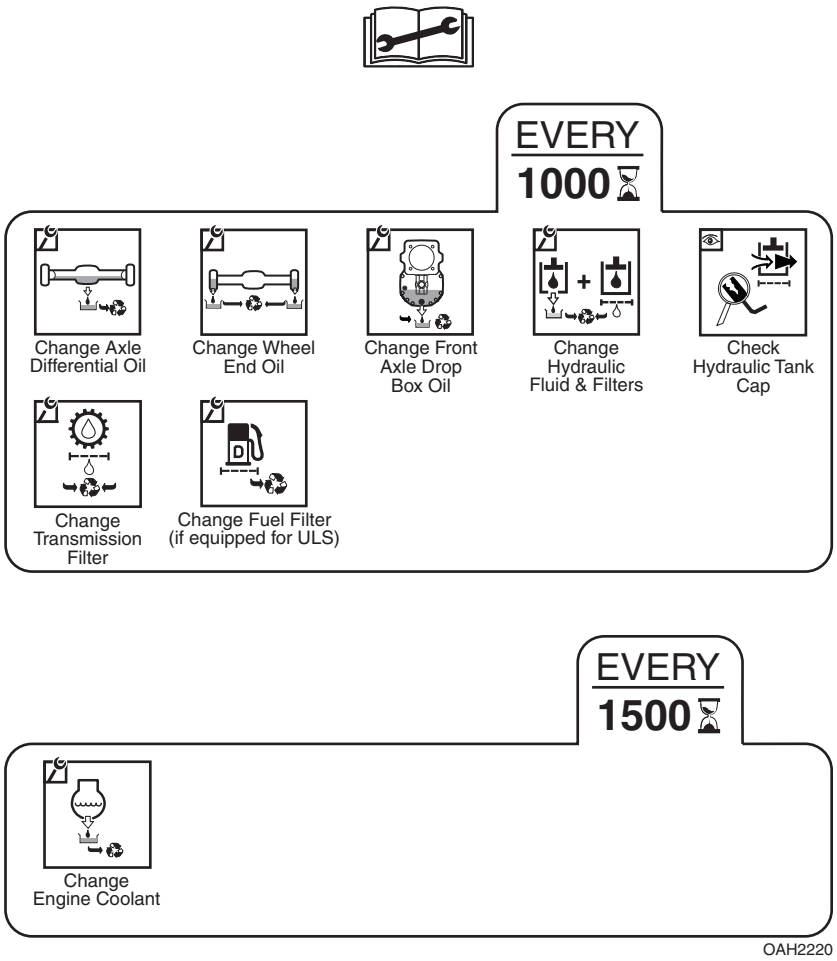
2.6.1 10,1st 50 & 50 Hour Maintenance Schedule



2.6.2 1st 250, 250 & 500 Hour Maintenance Schedule

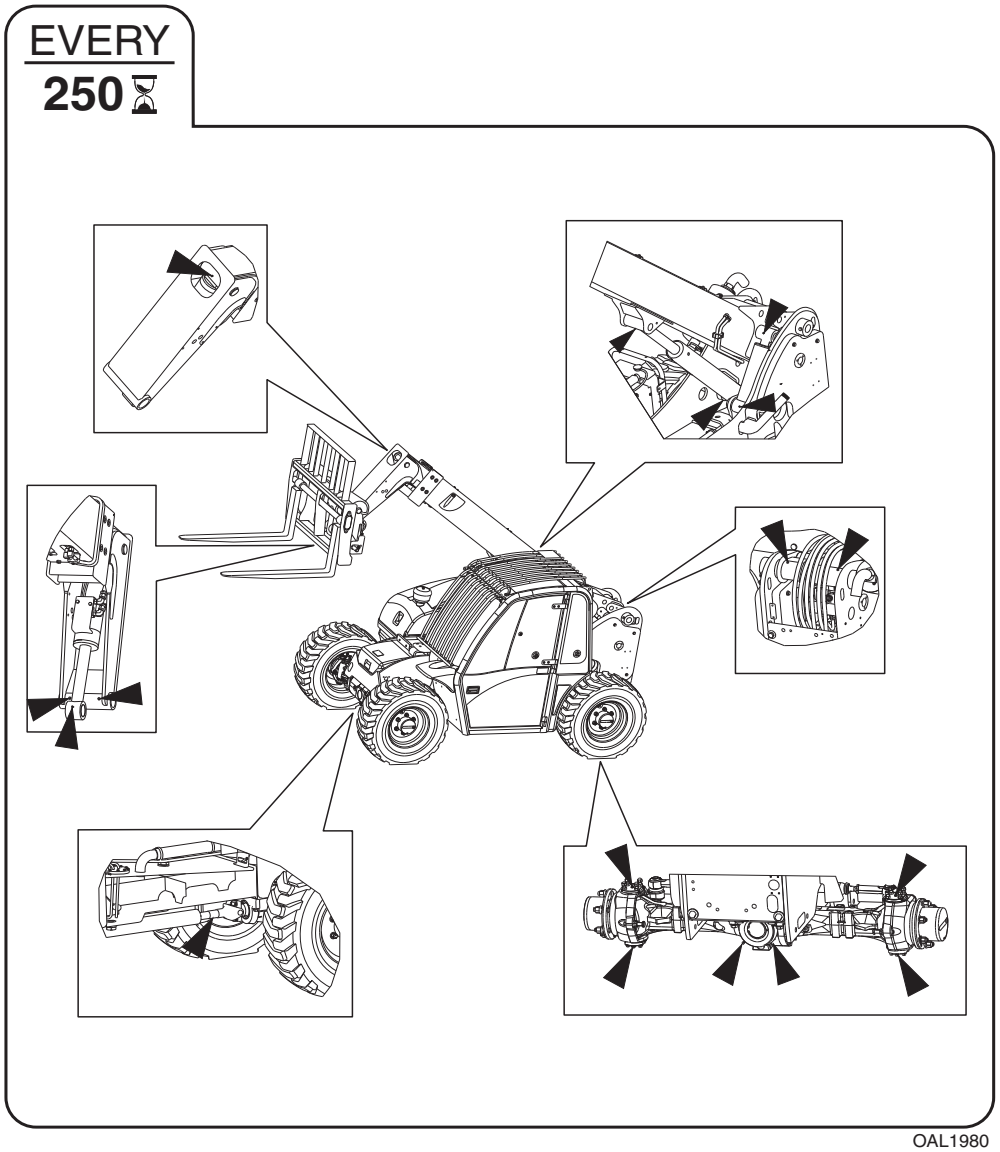


2.6.3 1000 & 1500 Hour Maintenance Schedule



2.7 LUBRICATION SCHEDULE

2.7.1 250 Hour Lubrication Schedule



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Section 3
Boom

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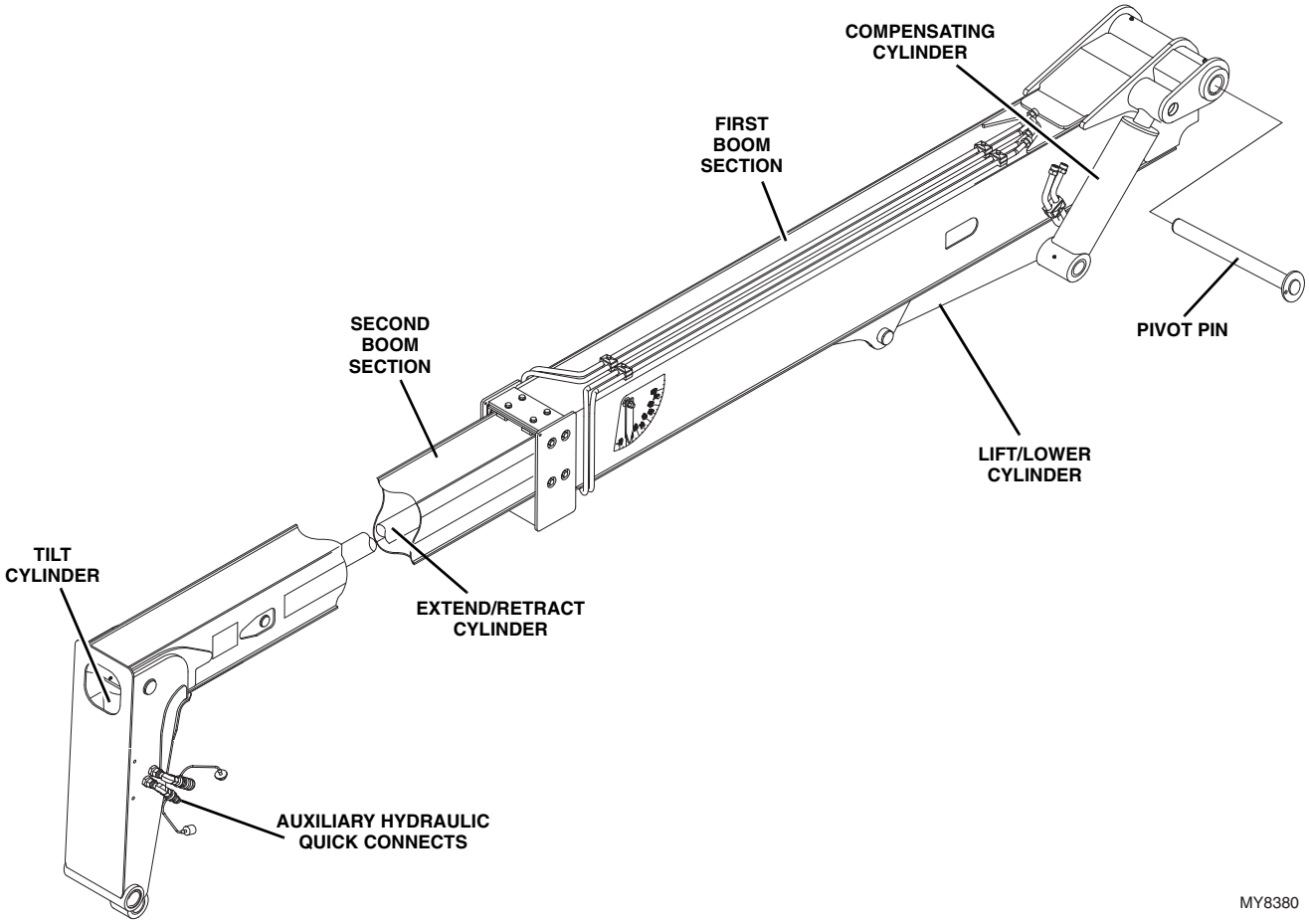
3.1 BOOM SYSTEM COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the boom system. The following illustration identifies the components that are referred to throughout this section.



3.2 SAFETY INFORMATION

WARNING

DO NOT service the machine without following all safety precautions as outlined in the “Safety Practices” section of this manual.

3.3 TWO SECTION BOOM SYSTEM

3.3.1 Boom System Description

Boom operates via an interchange among electrical, hydraulic and mechanical systems. Components involved include joystick, tilt cylinder, extend/retract cylinder, lift/lower cylinder, compensating cylinder, electronic sensors, various pivots, supporting hardware and other components.

WARNING

NEVER weld or drill the boom unless approved in writing by the manufacturer. The structural integrity of the boom will be impaired if subjected to any repair involving welding or drilling.

3.4 BOOM ASSEMBLY MAINTENANCE

Boom assembly consists of first and second section booms and supporting hardware.

Note: *Before removing boom or boom section, carriage or any other attachment must be removed from quick attach assembly.*

Before beginning, conduct a visual inspection of machine and work area, and review task about to be undertaken. Read, understand and follow these instructions.

During service of boom, perform following:

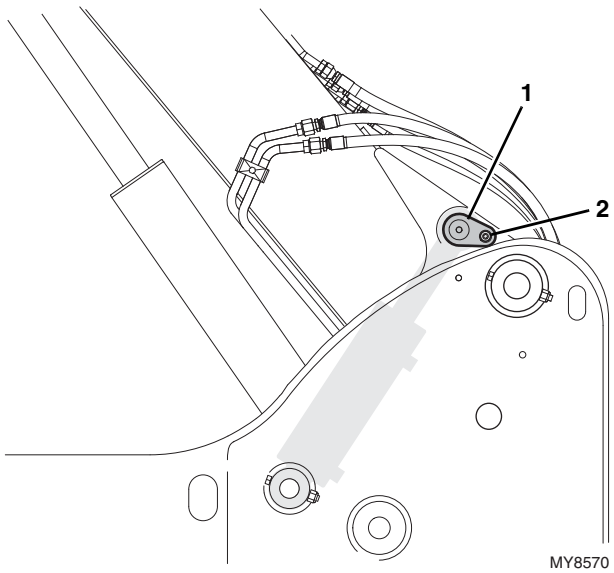
1. Check wear pads. (Refer to Section 3.5.1, “Wear Pad Inspection.”)
2. Apply grease at all lubrication points (grease fittings). (Refer to Section 2.7, “Lubrication Schedule.”)
3. Check for proper operation by operating all boom functions through their full ranges of motion several times.

Depending on your particular circumstance, the following procedures explain removal/installation of complete boom or removal/installation of individual boom sections.

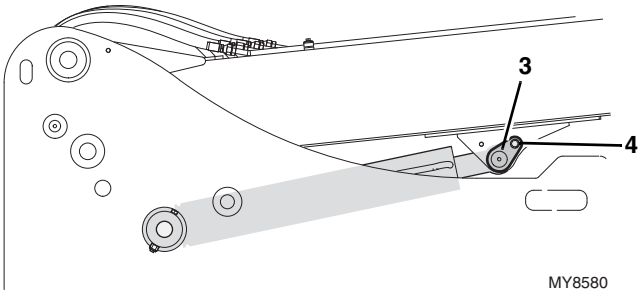
3.4.1 Complete Boom Removal

1. Remove any attachment from quick attach assembly.
2. Park machine on a hard, level surface.
3. Fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL.
4. Engage park brake and shut engine OFF.
5. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
6. Allow system fluids to cool.
7. Remove the quick attach assembly. Refer to Section 3.6.1, “Quick Attach Assembly Removal.”

Note: *The use of two slings will allow for better stability.*

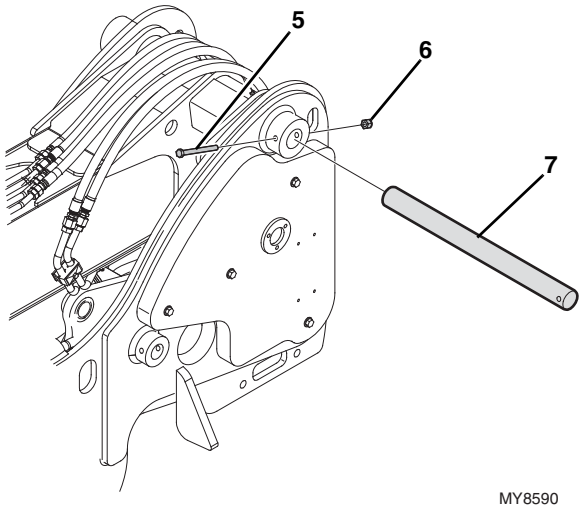


8. Start machine and raise boom to position that will allow for pin (**1**) to clear frame for removal.
9. Remove the lock bolt (**2**) and pin (**1**) from compensating cylinder.



10. Lower the boom to a position that allows for the removal of rod end pin (**3**) connecting lift/lower cylinder to boom.
11. Support boom by placing a sling(s) around boom head. Support lift/lower cylinder and remove lock bolt (**4**) and rod end pin (**3**). Lower lift/lower cylinder onto frame rails.
12. Properly disconnect battery.
13. Label and disconnect tilt and (if equipped) auxiliary hydraulic hoses attached to machine at tubes on top of boom. Plug and cap hose ends to prevent dirt and debris from entering hydraulic system.
14. Label and disconnect extend/retract hydraulic hoses at tubes on side of boom. Plug and cap hose ends to prevent dirt and debris from entering hydraulic system.
15. If equipped, disconnect the LSI boom proximity sensor at rear of first boom section.

Note: *Tag or identify each hose to the corresponding fitting it was removed from.*



16. Lower boom to a level position and place a suitable support under rear of boom. Reposition slings to each end of boom.
17. Remove capscrew (**5**) and locknut (**6**) securing boom pivot pin (**7**) and remove boom pivot pin.
18. Lift complete boom off machine and set on level ground or supports being careful not to damage tubes on bottom of boom.

3.4.2 Complete Boom Installation

Note: *Lubrication of boom wear surfaces with grease is recommended to keep boom wear surfaces lubricated properly. Lubrication of boom wear surfaces is also recommended when machine is stored, to help prevent rusting. Refer to Section 2.5, "Fluids, Lubricants and Capacities."*

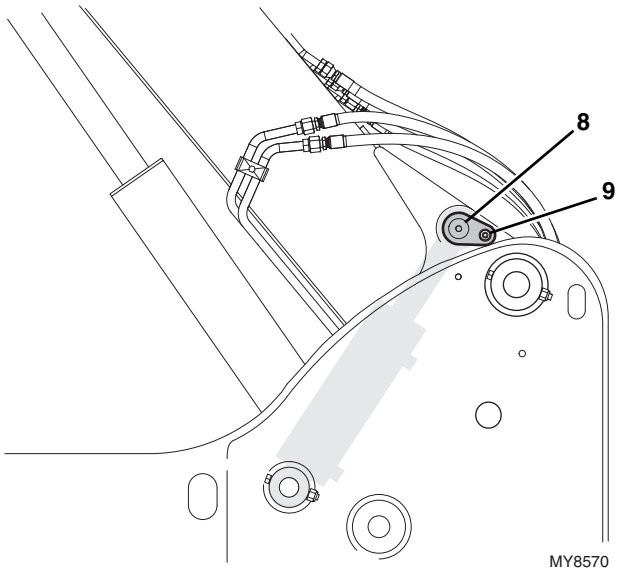
1. Park machine on a hard, level surface.
2. Place transmission control lever in (N) NEUTRAL.
3. Engage park brake and shut engine OFF.
4. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
5. Allow system fluids to cool.

Note: *Grease the boom pivot bore, compensating cylinder rod ends, lift/lower cylinder rod end and pins before installing.*

6. Balance boom assembly using suitable slings and carefully guide the boom into position for attachment to frame.
7. Align frame pivot bore with the boom assembly pivot bore. Install boom pivot pin (**7**)
8. Install capscrew (**5**). Apply locking compound and torque locknut (**6**) to 66 lb-ft (90 Nm).
9. With sling still in place, install rod end of the lift/lower cylinder, pin (**3**) and lock bolt (**4**). Apply locking compound and torque to 66 lb-ft (90 Nm).

Note: *Raising boom up or down with sling may be necessary so boom, compensating and lift/lower cylinder bores can be aligned for easier pin installation.*

10. Uncap and reconnect extend/retract cylinder fittings and plugs to extend/retract cylinder tubes and tighten until wrench-tight. Mark fitting, then torque to specification. Refer to Section 2.3.3, “Hydraulic Hose Torque Chart.”
11. Uncap and reconnect tilt hoses and (if equipped) auxiliary hoses. Attach both sets to their appropriate fittings until wrench-tight. Mark fitting, then torque to specification. Refer to Section 2.3.3, “Hydraulic Hose Torque Chart.”



12. Raise boom to height that allows for installation of compensating cylinder, pin (**8**) and lock bolt (**9**). Apply locking compound and torque to 66 lb-ft (90 Nm).
13. Adjust and shim each wear pad as needed.
14. Start engine and operate all boom functions several times to bleed any air out of hydraulic system.
15. Check for fluid leaks.
16. Check the hydraulic fluid level in tank and add fluid as required.
17. Clean up all debris, hydraulic fluid, etc., in, on, near and around the machine.
18. Close and secure engine cover.
19. Remove Do Not Operate Tags from both ignition key switch and the steering wheel.
20. Install previously removed attachment to quick attach assembly.

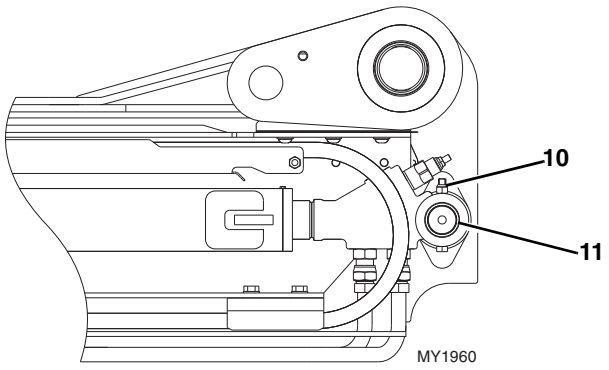
3.4.3 Second Boom Section Removal

1. Remove any attachment from quick attach assembly.
2. Be sure there is enough room in front of machine to allow boom sections to be removed.
3. Park machine on a hard, level surface.
4. Fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL.
5. Engage park brake and shut engine OFF.
6. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
7. Properly disconnect battery.
8. Open engine cover. Allow system fluids to cool.
9. Remove quick attach assembly. Refer to Section 3.6.1, “Quick Attach Assembly Removal.”
10. Label and disconnect tilt hoses and (if equipped) auxiliary hydraulic hoses attached to machine at boom head. Plug and cap hose ends to prevent dirt and debris from entering hydraulic system.

Note: *Tag or identify each hose to corresponding fitting it was removed from.*

11. Label and disconnect extend/retract hydraulic tubes on extend/retract cylinder at the rear of boom. Plug and cap hose ends to prevent dirt and debris from entering hydraulic system.
12. Remove top and side wear pads from rear of second boom section.

Note: *Tag each pad, backing plate, shim and bolts from each location.*



13. Remove lock bolt and nut (**10**) from rear of extend/retract cylinder.
14. Remove extend/retract cylinder mounting pin (**11**).
15. Support front of boom by placing a sling behind boom head.

16. Pull second boom section out of first boom section approximately 6 in to 8 in (15 cm to 20 cm).
17. Pull tilt hoses and (if equipped) auxiliary hydraulic hoses through rear of boom.
18. Remove top, side and bottom wear pads from front of first boom section.

Note: *Tag each pad, backing plate, shim and bolts from each location.*

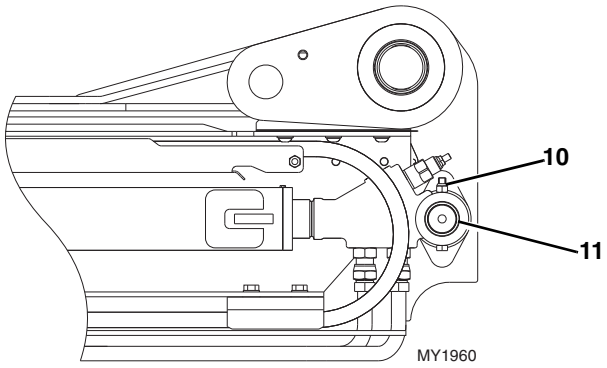
Note: *The use of two slings will allow for better stability.*

19. Pull second boom section halfway out of first boom section, reposition sling(s), balancing second boom section and remove from first boom section.
20. Place second boom section on suitable stands to begin tear down.
21. Inspect boom and welds. Consult local **JLG** Dealer if structural damage is detected.
22. Inspect hoses, hardware, wear pads, mounting points and other components visible with first boom section. Replace any item if damaged.
23. Inspect all wear pads for wear. (Refer to Section 3.5.1, “Wear Pad Inspection.”)

3.4.4 Second Boom Section Installation

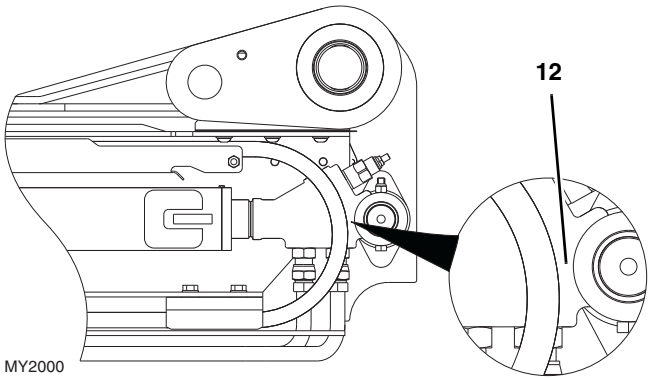
Note: *Lubrication of boom wear surfaces with grease is recommended to keep boom wear surfaces lubricated properly. Lubrication of boom wear surfaces is also recommended when machine is stored, to help prevent rusting. Refer to Section 2.5, “Fluids, Lubricants and Capacities.”*

1. If previously removed, install extend/retract cylinder into rear of second boom section. Pin and clip barrel end of cylinder in place.
2. Install wear pads, shims and bolts to their proper location at front inside of first boom section. **DO NOT** tighten wear pads at this time.
3. Feed the tilt cylinder hoses and if equipped, the auxiliary hoses through the channel above the extend/retract cylinder.
4. Using suitable sling(s), balance second boom section, lift and carefully guide boom into place.



5. Install extend/retract cylinder mounting pin (**11**).
6. Install lock bolt and nut (**10**) at rear of extend/retract cylinder.
7. Install wear pads, shims and bolts previously removed from rear of second boom section. **DO NOT** tighten the wear pads at this time.
8. Uncap and reconnect extend/retract cylinder fittings and plugs from extend/retract cylinder tubes and tighten until wrench-tight. Mark fitting, then torque to specification. Refer to Section 2.3.3, “Hydraulic Hose Torque Chart.”
9. Uncap and reconnect tilt hoses and (if equipped) auxiliary hoses. Attach both sets to their appropriate fittings until wrench-tight. Mark fitting, then torque to specification. Refer to Section 2.3.3, “Hydraulic Hose Torque Chart.”
10. Adjust and shim each wear pad as needed.
11. Properly connect battery.

12. Start engine and operate all boom functions several times to bleed any air out of hydraulic system. Check for fluid leaks. Check hydraulic fluid level in tank and add fluid as required.

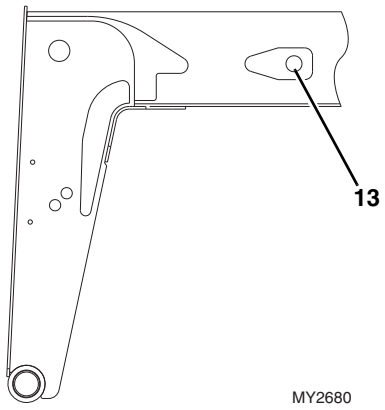


13. Check clearance (**12**) between the tilt hoses (and if equipped) auxiliary hoses and the front of the extend/retract cylinder trunnion. There should be approximately 1/2 in. (12,7 mm) of clearance.
14. If adjustment is needed, loosen the tilt tubes (and if equipped) auxiliary tubes. Move tubes to achieve the proper clearance.
15. Clean up all debris, hydraulic fluid, etc., in, on, near and around the machine.
16. Close and secure the engine cover.
17. Remove Do Not Operate Tags from both ignition key switch and the steering wheel.
18. Install previously removed attachment to quick attach assembly.

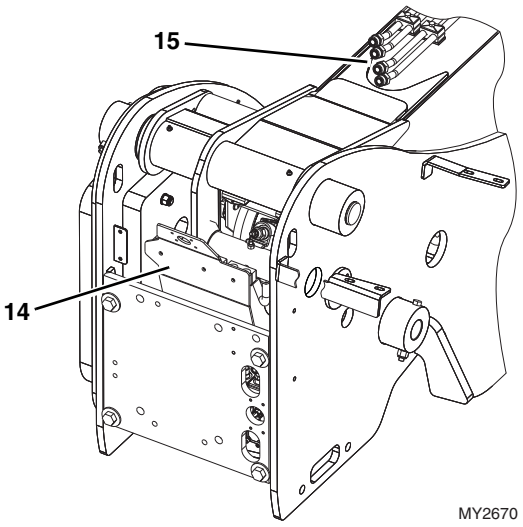
3.4.5 Extend/Retract Cylinder Removal

Note: *Boom must be properly aligned (level) with access hole at rear of frame to allow removal of extend/retract cylinder barrel mounting pin.*

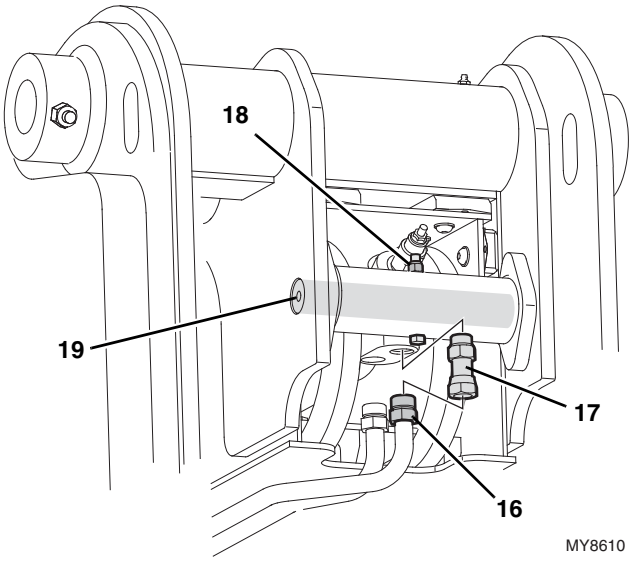
1. Remove any attachment from quick attach assembly.
2. Be sure there is enough room in front of machine to allow boom sections to be removed.
3. Park machine on a hard, level surface.
4. Fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL.
5. Engage park brake and shut engine OFF.
6. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
7. Open engine cover and properly disconnect battery.
8. Allow system fluids to cool.
9. Remove the quick attach assembly. Refer to Section 3.6.1, “Quick Attach Assembly Removal.”



10. Remove cylinder rod eye retaining clips and mounting pin (**13**) at side of second boom section.



11. Loosen and remove hose clamps and cover plate (**14**) from rear of boom assembly.
12. Remove any miscellaneous parts such as mirror if they will interfere with removal of cylinder.
13. Label and disconnect tilt and (if equipped) auxiliary hydraulic hoses attached to machine on top of boom (**15**). Plug and cap hose ends to prevent dirt and debris from entering hydraulic system.



14. Loosen and remove both extend/retract cylinder tubes (**16**) at rear of first boom section. Plug tube ends to prevent dirt and debris from entering hydraulic system.
15. Loosen and remove both fittings (**17**) from bottom of extend/retract cylinder barrel. Plug openings in extend/retract cylinder barrel.
16. Loosen and remove hardware (**18**) securing on cylinder barrel mounting pin.
17. Remove cylinder barrel mounting pin (**19**). Note location of spacers and washers.
18. Attach a sling or other suitable lifting device to extend/retract cylinder and carefully pull cylinder free from machine through rear of boom/chassis.

Note: *The tilt hoses and if equipped, auxiliary hoses may need to be moved during removal of extend/retract cylinder.*

3.4.6 Extend/Retract Cylinder Installation

1. Carefully install the extend/retract cylinder into rear of boom using a suitable sling.
2. Line up barrel end of cylinder with pin bores on first boom section.

Note: *The tilt hoses and (if equipped) the auxiliary hoses may need to be moved during installation of the extend/retract cylinder.*

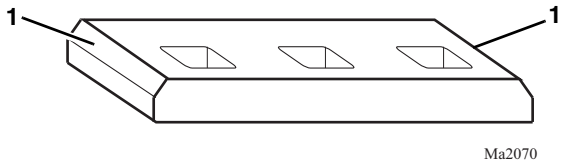
3. Install mounting pin (**19**), spacers and washers through frame access hole on chassis and first boom section bore and cylinder barrel. Secure with hardware (**18**) removed earlier.
4. Remove plugs in bottom of extend/retract cylinder and install previously removed fittings (**17**).
5. Uncap and connect tubes (**16**) to previously labeled fittings at extend/retract cylinder. Apply locking compound to fittings.
6. Uncap and reconnect tilt hoses and (if equipped) auxiliary hoses (**15**) to their appropriate fittings until wrench-tight. Mark the fitting and torque to specification. Refer to Section 2.3.3, “Hydraulic Hose Torque Chart.”
7. Install cover plate (**14**) and hose clamps at rear of boom assembly.
8. Reinstall any miscellaneous parts, such as mirror, if removed previously.
9. Properly connect battery.
10. Start machine and extend the extend/retract cylinder until rod eye of cylinder aligns with pin bore in second boom section.
11. Shut the engine OFF.
12. Install mounting pin through side of second boom section (**13**) and secure with retaining clips.
13. Start machine and cycle extend/retract cylinder to bleed any air out of hydraulic system.
14. Check for fluid leaks or any alignment problems.
15. Check the hydraulic fluid level in tank and add fluid as required.
16. Clean up all debris, hydraulic fluid, etc., in, on, near and around the machine.
17. Close and secure the engine cover.
18. Remove Do Not Operate Tags from both ignition key switch and the steering wheel.
19. Install previously removed attachment to quick attach assembly.

3.5 BOOM WEAR PADS

A total of 14 wear pads are installed on the boom.

Twelve of fourteen wear pads on this boom are flat rectangular wear pads with metal inserts. Two wear pads on bottom of second section boom are channeled for tilt hose and auxiliary hose clearance.

3.5.1 Wear Pad Inspection



Inspect all wear pads for wear. If angle indicators (1) on end of wear pads are visible, wear pads can be reused. If the wear pads show uneven wear (front to back), they should be replaced. Replace wear pads as a set if worn or damaged.

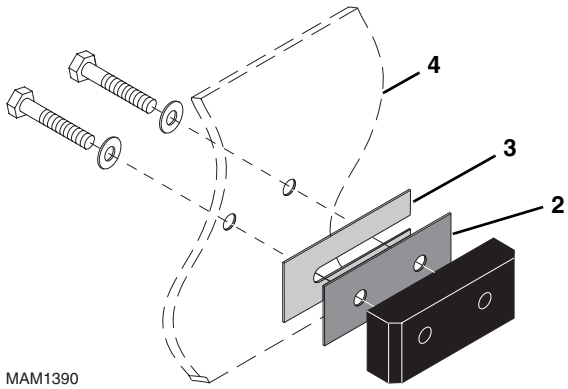
3.5.2 Wear Pad Installation and Lubrication

Note: *Inspect all wear pads. Replace as necessary.*

The following wear pad procedure must be followed to insure proper wear pad installation:

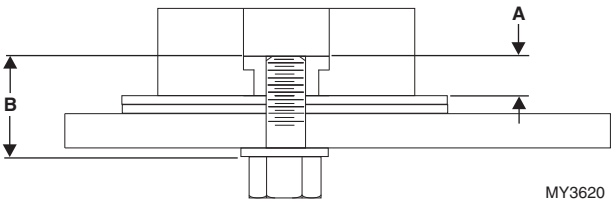
Note: *MUST clean wear pad inserts and mounting bolts of any grease, oil or other contaminates before applying locking compound and installing mounting bolts.*

- Apply locking compound to all the wear pad mounting bolts.



- Assemble as shown using spacer (**2**) with holes before any shim (**3** is used.
- If required, a shim (**3**) must inserted between the spacer (**2**) and wear pad support plate, block or boom section (**4**).

- The number of shims can vary at each shim point.
- The bottom wear pads must be shimmed equally on each side.
- Maintain a total boom section clearance of 0.070-0.130 in (1,78-3,30 mm) both the horizontal and vertical directions.



- The length of wear pad bolt depends on number of shims, spacers and washers being used.
- The thickness of each threaded wear pad insert is 0.312 in (7,92 mm)(**A**).
- The bolt length should be determined by measuring distance from face of insert to face of boom (**B**) including any spacer, shim(s) and washer(s).
- Bolt thread engagement in wear pad insert should be 0.275 ± 0.040 in (6,98 ± 1,0 mm).
- One or two hardened washers are to be used on each wear pad bolt except where noted otherwise. DO NOT use more than two hardened washers.
- Use only one hardened washer if mounting bolts are recessed.
- Wear Pad Bolt Torque:
  3/8–24 Bolt, 32–37 lb-ft (43–50 Nm)
  3/8–24 Hollow Bolt, 15–17 lb-ft (20–23 Nm)
  1/2–20 Bolt, 76–86 lb-ft (103–116 Nm)
  1/2–20 Hollow Bolt, 45–50 lb-ft (61–68 Nm)
- Torque wear pad bolts after shimming is completed.
- Lubricate face and pockets of each wear pad after being installed.

3.5.3 Boom Wear Pad Lubrication

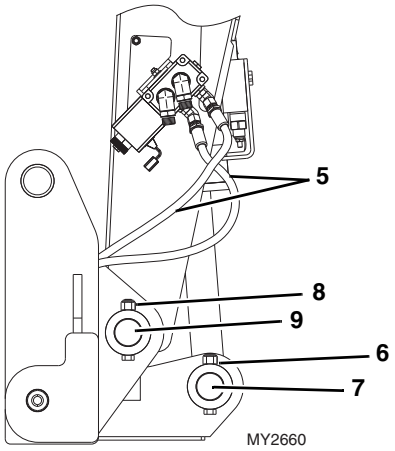
After replacing any wear pads or after prolonged periods of inoperation, *Lubrication of boom wear surfaces with grease is recommended to keep boom wear surfaces lubricated properly. Lubrication of boom wear surfaces is also recommended when machine is stored, to help prevent rusting. Refer to Section 2.5, "Fluids, Lubricants and Capacities."*

Note: *The first shim under the pad needs to contain holes, instead of slots.*

3.6 QUICK ATTACH ASSEMBLY

3.6.1 Quick Attach Assembly Removal

1. Park machine on a hard, level surface.
2. Fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL.
3. Engage park brake and shut engine OFF.
4. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
5. Properly disconnect battery.
6. Open engine cover. Allow system fluids to cool.



7. If equipped with a hydraulic quick attach device, remove both hydraulic hoses (**5**) from valve on left side of boom head. Plug and cap hose ends to prevent dirt and debris from entering system.
8. Remove the lock bolt (**6**) holding tilt cylinder rod end pin (**7**) to quick attach assembly. Remove pin.
9. Support quick attach assembly. Remove lock bolt (**8**) holding quick attach pin (**9**) to quick attach assembly. Remove pin.
10. Inspect pins for nicks or surface corrosion. Use fine emery cloth to fix minor nicks or corrosion.
11. Replace pins if damaged or beyond repair.

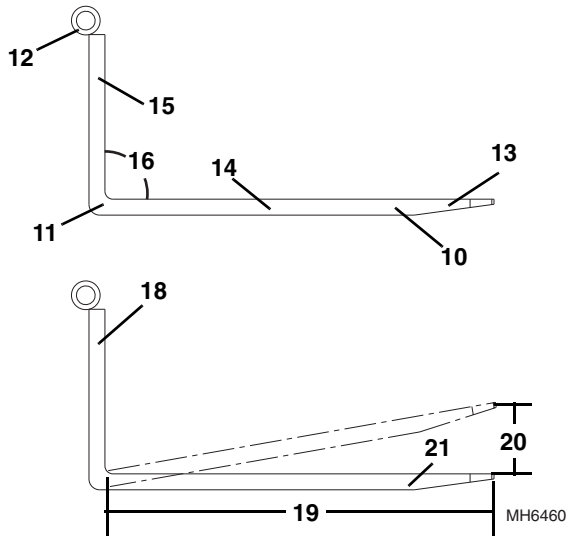
3.6.2 Quick Attach Assembly Installation

1. Line up quick attach assembly between mounts on boom head. Quick attach assembly should be centered in boom head.
2. Coat quick attach pivot pin (**9**) with an anti-seize compound. Insert quick attach pivot pin through quick attach assembly and boom head. Align pivot pin and quick attach assembly. Install lock bolt (**8**). Torque to 72 lb-ft (97 Nm).
3. Align quick attach assembly with tilt cylinder rod end and insert tilt cylinder pin (**7**). Align tilt cylinder pin and quick attach assembly. Install lock bolt (**6**). Torque to 72 lb-ft (97 Nm).
4. If equipped, uncap and reconnect hydraulic quick attach assembly device hoses (**5**) to valve on left side of boom head.
5. Clean up all debris, hydraulic fluid, etc., in, on, near and around machine.
6. Properly connect battery.
7. Close and secure engine cover.
8. Remove a Do Not Operate Tag on both ignition key switch and steering wheel.

3.7 FORKS

Forks should be cleaned and inspected prior to being attached to carriage. If the following criteria is not met, forks must be removed from service immediately.

Daily Inspection



1. Inspect forks (**10**) for cracks, paying special attention to heel (**11**) and mounting tubes (**12**).
2. Inspect forks for broken or bent tips (**13**) and twisted blades (**14**) and shanks (**15**).

Yearly Inspection

1. Straightness of the upper face of blade (**14**) and the front face of shank (**15**) should not exceed 0.5 percent of the length of blade or height of shank.
2. Angle (**16**) between upper face of blade and front face of shank should not exceed 93 degrees.
3. Thickness of blade (**17**) and shank (**18**) should not be reduced to 90 percent of original thickness.

Note: *Contact local **JLG** dealer with fork part number to find manufactured dimensions of fork blade.*

4. Ensure that fork length (**19**) is adequate for the intended loads.
5. Fork markings should be legible, re-stamp if required.
6. Compare fork tips (**20**) when mounted on a carriage. Maximum difference in height of fork tips is 3 percent of length of blade (**21**).

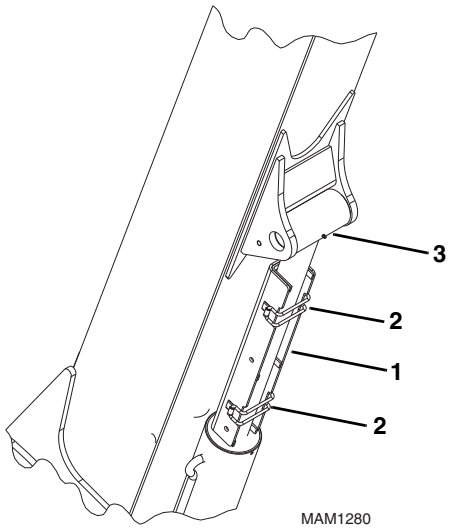
3.8 BOOM PROP (IF EQUIPPED)

3.8.1 Prop Installation

⚠ WARNING

A raised boom can fall if a hydraulic component is removed. Remove any load, retract the boom and install the boom prop or a suitable supporting stand before working under a raised boom.

1. Park the machine on a firm, level surface. Place the transmission control lever in (N) NEUTRAL, engage the park brake switch.
2. Raise the boom to an angle of approximately 20 degrees. Shut engine OFF.
3. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
4. Before installing boom prop, inspect prop for damage. Do not use if prop is damaged or if o-rings are damaged or missing.



5. Install boom prop (**1**) onto lift/lower cylinder. Install o-rings (**2**). Align lift cylinder lock so o-rings are on bottom side of lift/lower cylinder rod.
6. Start engine and SLOWLY lower boom until there is a clearance of 0.25 in (6 mm) between end of boom prop and lift/lower cylinder rod end (**3**).
7. Shut engine OFF.

NOTICE

EQUIPMENT DAMAGE. DO NOT operate with the boom prop in place. Damage to the boom prop and/or the lift/lower cylinder could occur.

3.8.2 Prop Removal

1. If needed, start machine and slowly raise the boom until the boom prop is clear of the lift/lower rod end.
2. Remove the o-rings (**2**) and boom prop (**1**) from the cylinder. Return the boom prop to the proper location and secure.
3. Lower boom, shut engine OFF.

3.9 EMERGENCY BOOM LOWERING PROCEDURE

⚠ WARNING

To avoid instability of the machine, the extend/retract cylinder **MUST BE** fully retracted prior to retracting the lift cylinder. If circumstances prevent retraction of the extend/retract cylinder first, lower the lift cylinder the minimum amount necessary and resume retraction of the extend/retract cylinder as soon as possible.

⚠ WARNING

Properly support the boom before attempting to proceed with the emergency boom lowering procedure.

⚠ WARNING

If possible, safely remove and/or secure the load on the machine before starting the boom lowering procedure. If load cannot be removed, the machine load chart MUST be followed.

3.9.1 Equipment and Supplies Required

Auxiliary Hydraulic Power Supply:

- Portable hydraulic unit or another machine with an auxiliary hydraulic power supply with a capacity to hold up to 3 gal (11,4 L) of hydraulic oil from the machine during lowering process.

NOTICE

EQUIPMENT DAMAGE. Auxiliary Hydraulic Power Supply hydraulic oil must be compatible with hydraulic oil shown in Section 2.5, “Fluids, Lubricants and Capacities.”

Hoses:

- Two Hydraulic Hoses - Approximately 10 ft (3,0 m) each, with a minimum I.D. of 0.375 in. (9,5 mm) and a minimum rating of 4000 psi (275,8 bar).

Fittings:

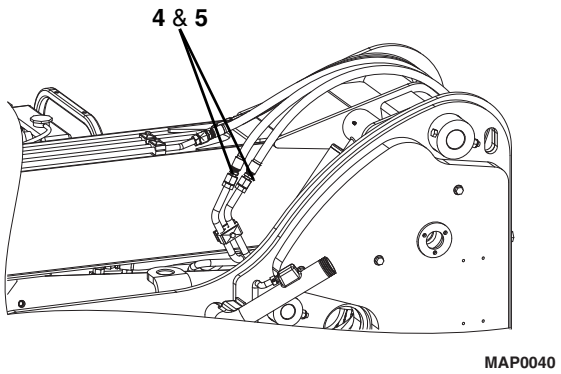
- Two 1 in. (25,4 mm) - 14 ORFS Caps
- Two 1 in. (25,4 mm) - 14 ORFS Plugs

Note: *Machine extend/retract and lift/lower hoses are - 14 ORFS. The adaptor size may vary depending on the hose ends of the auxiliary hydraulic power supply.*

3.9.2 Lowering Procedure

a. Retract the boom as follows:

1. Place a suitable receptacle under hose connections.



VIEW FROM LEFT SIDE

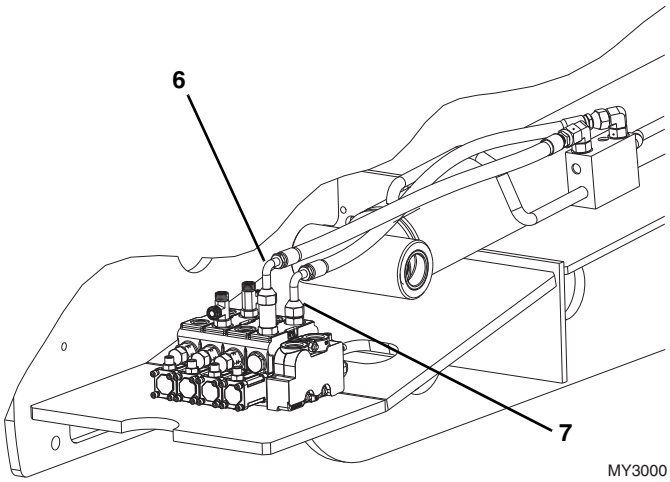
2. Locate the extend/retract cylinder connection (**4** and **5**) along the left side of the boom where the hoses from the valve connect to the steel tube.
3. Label and disconnect hoses from steel tubes along left side of boom. Install plugs in hoses to prevent fluid loss. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.

Note: *Loss of hydraulic oil is limited to amount trapped within each hose.*

4. Using hoses and fittings specified previously, connect jumper hoses between auxiliary hydraulic power supply and steel tubes (**4** and **5**) connected to extend/retract cylinder of affected machine. Ensure that supply and return lines are installed in proper order to ensure cylinder is retracted, not extended.
5. Use the auxiliary power supply to retract the extend/retract cylinder.
6. Loosen and remove the jumper hoses and reconnect extend/retract cylinder hoses.
7. Transfer any hydraulic oil into a suitable, covered container, and label the container as “Used Oil.” Dispose of used oil at an approved recycling facility.
8. Clean up all debris, hydraulic fluid, etc., in, on, near and around machine.

b. Lower the boom as follows:

1. Place a suitable receptacle under main control valve.



2. Label and disconnect lift/lower cylinder hoses (**6** and **7**) from main control valve. Install plugs in hoses to prevent fluid loss. Cap all fittings and openings to keep dirt and debris from entering hydraulic system.

Note: *Loss of hydraulic oil is limited to amount trapped within each hose.*

3. Using hoses and fittings specified, connect hoses between auxiliary hydraulic power supply and hoses removed from main control valve lift/lower section of affected machine. Hose (**7**) is supply (lower) and hose (**6**) is return. Connect hoses in proper order to ensure that boom is lowered, not raised.
4. Use auxiliary power supply to retract lift cylinder.
5. After boom has been lowered, loosen and remove jumper hoses and reconnect lift/lower cylinder hoses at main control valve.
6. Transfer any hydraulic oil into a suitable, covered container, and label the container as “Used Oil.” Dispose of used oil at an approved recycling facility.
7. Clean up all debris, hydraulic fluid, etc., in, on, near and around the machine.

3.10 TROUBLESHOOTING

This section provides an easy reference guide covering the most common problems that occur during operation of the boom.

Problem	Possible Causes	Remedy
1. Boom will not extend or retract.	1. Broken hydraulic hose(s) or tube(s) and/or connections leaking.	1. Locate break, replace hose(s) or tube(s), tighten connections.
	2. Extend/Retract hydraulic system not operating properly.	2. Refer to Section 8.7, “Hydraulic Schematic.”
	3. Faulty extend/retract cylinder.	3. Repair cylinder (Refer to Section 8.12, “Hydraulic Cylinders.”)
2. Boom will not fully extend.	1. Extend/retract hydraulic system not operating properly.	1. Refer to Section 8.7, “Hydraulic Schematic.”
3. Boom shifts to right or left when extending.	1. Boom side wear pads improperly shimmed or worn.	1. Shim wear pads to correct gap. Replace wear pads as needed. Refer to Section 3.5.2, “Wear Pad Installation and Lubrication.”
4. Excessive pivot pin noise and/or wear.	1. Insufficient lubrication.	1. Lubricate at regular intervals. (Refer to Section 2.7, “Lubrication Schedule.”) Replace worn pins as needed.
	2. Worn bushing(s).	2. Replace bushing(s) and lubricate at regular intervals (Refer to Section 2.7, “Lubrication Schedule.”)
5. Boom will not raise or lower.	1. Broken hydraulic hoses or tubes and/or connection leaks.	1. Locate break, replace hose(s) or tube(s), tighten connections.
	2. Lift/lower hydraulic system not operating properly.	2. Refer to Section 8.7, “Hydraulic Schematic.”
	3. Faulty lift cylinder.	3. Repair cylinder. (Refer to Section 8.12, “Hydraulic Cylinders.”)
	4. Seized boom pivot pin bushing.	4. Replace bushing.

Problem	Possible Causes	Remedy
6. Rapid boom pad wear.	1. Incorrect wear pad gap.	1. Check wear pad gaps and correct as needed. Refer to Section 3.5.2, “Wear Pad Installation and Lubrication.”
	2. Rapid cycle times with heavy loads.	2. Reduce cycle times.
	3. Contaminated, corroded or rusted wear pad sliding surfaces.	3. Remove contamination and/or corrosion from wear pad sliding surfaces and lubricate. If the surfaces cannot be reconditioned, replace the boom section(s).
	4. Operating in extremely dusty/ abrasive conditions.	4. Clean equipment frequently.
7. Auxiliary hydraulics will not operate.	1. Auxiliary hydraulic system not operating properly.	1. Refer to Section 8.7, “Hydraulic Schematic.”

Section 4
Cab

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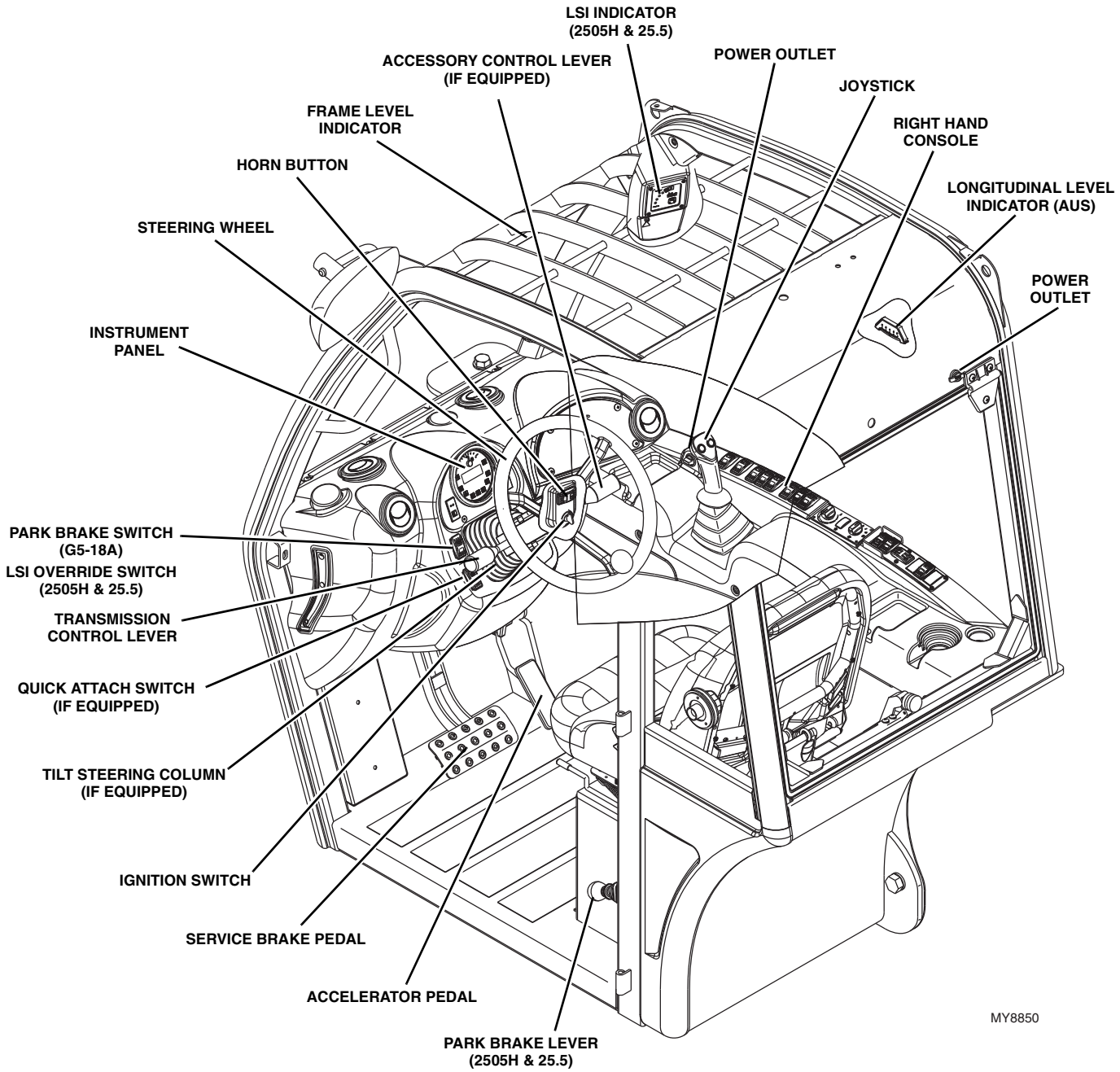
4.1 OPERATOR CAB COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the machine cab and covers. The following illustration identifies the components that are referred to throughout this section.



4.2 SAFETY INFORMATION

WARNING

DO NOT service the machine without following all safety precautions as outlined in the “Safety Practices” section of this manual.

4.3 OPERATOR CAB

4.3.1 Operator Cab Description

The welded metal cab features a modular design, allowing for a relatively quick, simple exchange of entire cab and/or component parts. Cab is bolted directly to frame.

The operator cab is a protective structure. The cab itself contains rollover protective and falling object protective structures (ROPS/FOPS) for operator.

WARNING

DO NOT weld, grind, drill, repair or modify the cab in any way. Any modification or damage to cab structural components requires cab replacement.

To help ensure optimum safety, protection and performance, replace cab if it is damaged. Refer to appropriate parts manual for ordering information.

The cab contains seat, operating controls, numerous panels, steering and brake components and more.

Covers and mirrors on machine exist for safety, protection and appearance. They are relatively simple to remove and replace.

4.3.2 Serial Number Decal

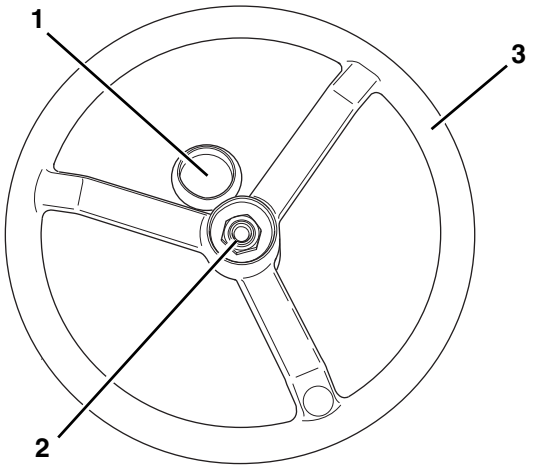
The cab serial number decal is located inside cab, under the seat. Information specified on serial number plate includes cab model number, cab serial number and other data. Write this information down in a convenient location to use in cab correspondence.

4.4 CAB COMPONENTS

4.4.1 Steering Wheel

a. Steering Wheel Removal

1. Park machine on a hard, level surface.
2. Fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL.
3. Engage park brake and shut engine OFF.
4. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
5. Properly disconnect battery.
6. Open engine cover. Allow system fluids to cool.



MAH0430

7. Carefully pry center button (**1**) out of steering wheel.
8. Mark steering wheel and shaft to ensure proper installation. Remove nut (**2**) securing steering wheel (**3**) to splined steering column shaft.
9. Use a steering wheel puller to remove steering wheel (**3**) from splined shaft.

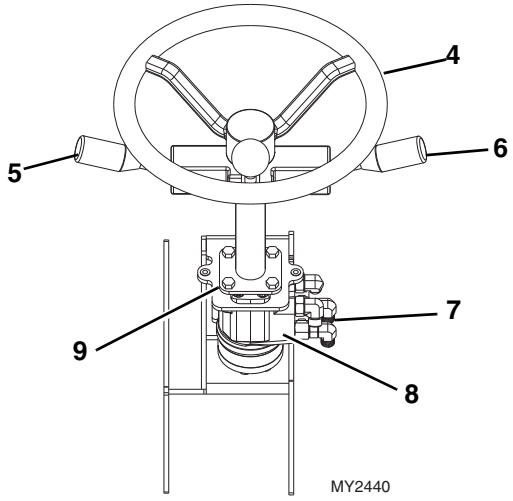
b. Steering Wheel Installation

1. Install steering wheel (**3**) onto splined steering column shaft.
2. Secure steering wheel with nut (**2**).
3. Press center button (**1**) onto steering wheel.
4. Properly connect battery.
5. Close and secure engine cover.
6. Remove a Do Not Operate Tag on both ignition key switch and steering wheel.

4.4.2 Steering Column/Valve Replacement

a. Steering Column and Valve Removal

1. Park machine on a hard, level surface.
2. Fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL.
3. Engage park brake and shut engine OFF.
4. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
5. Properly disconnect battery.
6. Open engine cover. Allow system fluids to cool.



7. Remove steering wheel (**4**) (Refer to Section 4.4.1, “Steering Wheel.”), transmission control lever (**5**) and accessory lever (if equipped)(**6**).
8. Loosen and remove steering column cover.
9. Loosen and remove dash cover.
10. Label, disconnect and cap hydraulic hoses (**7**) and fittings on steering orbitrol valve (**8**).
11. Remove four hex-flange capscrews (**9**) (three if machine is equipped with tilt column) connecting orbitrol valve to steering column.
12. Pull steering column assembly and orbitrol valve from machine cab.

Note: ***DO NOT*** *disassemble the steering orbitrol valve. The steering orbitrol valve is not serviceable and must be replaced in its entirety, if defective.*

b. Steering Column and Valve Installation

1. Install four hex-flange capscrews (three if machine is equipped with tilt column) through steering column, mounting bracket and into top of orbitrol valve.

Note: *ALWAYS use new o-rings when servicing the machine.*

2. Uncap and install new o-rings into fittings. Lubricate o-rings with clean hydraulic oil.
3. Uncap and reconnect previously labeled hydraulic hoses to their appropriate locations.
4. Install dash cover.
5. Install steering column cover.
6. Install steering wheel (Refer to Section 4.4.1, “Steering Wheel.”), accessory lever and transmission control lever.
7. Properly connect battery.
8. Carefully examine all connections one last time before engine start-up. Rectify any faulty conditions.
9. Start engine and check operation of all controls. Check for fluid leaks. Check hydraulic fluid level in tank and add fluid as required.
10. Clean up all debris, hydraulic fluid, etc., in, on, near and around the machine.
11. Close and secure engine cover.
12. Remove a Do Not Operate Tag on both ignition key switch and steering wheel.

c. Power Steering Test

Conduct a pressure check of the steering hydraulic circuits at the test port on the implement pump. Refer to Section 8.6.5, “Steering Pressure Checking.”

4.4.3 Brake Pedal and Valve

a. Brake Valve Removal

Refer to Section 8.11.2, a. “Service Brake Valve Removal,” for removal information.

b. Brake Valve Installation

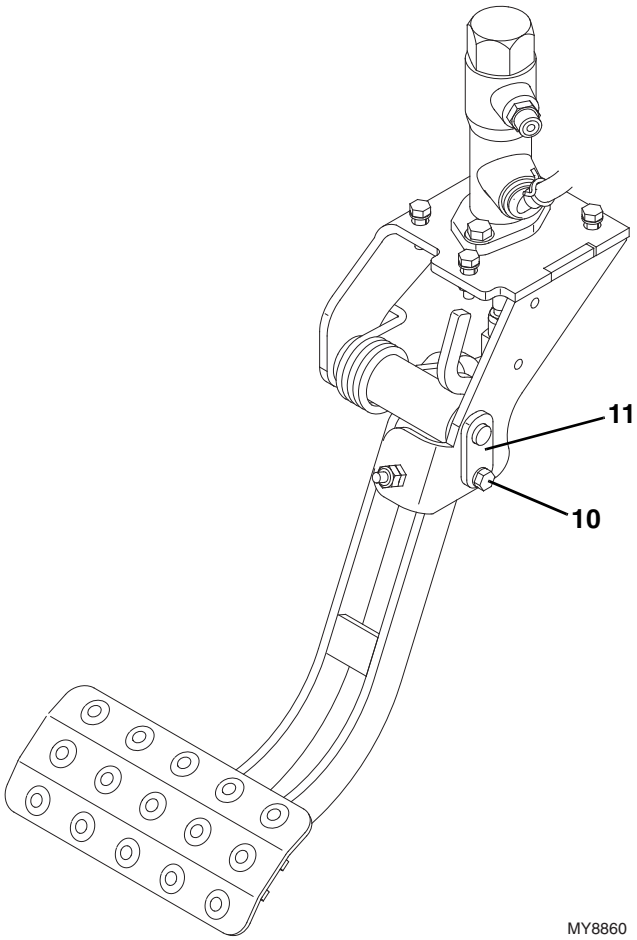
Refer to Section 8.11.2, b. “Service Brake Valve Installation,” for installation information.

c. Service Brake Pedal Removal

1. Park machine on a hard, level surface.
2. Fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL.
3. Engage park brake and shut engine OFF.
4. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
5. Properly disconnect battery.
6. Open engine cover. Allow system fluids to cool.
7. Remove the lower dash cover.
8. Remove hardware (**10**).
9. Remove pin (**11**) and return spring securing service brake pedal to cab.
10. Remove service brake pedal from cab.

d. Service Brake Pedal Installation

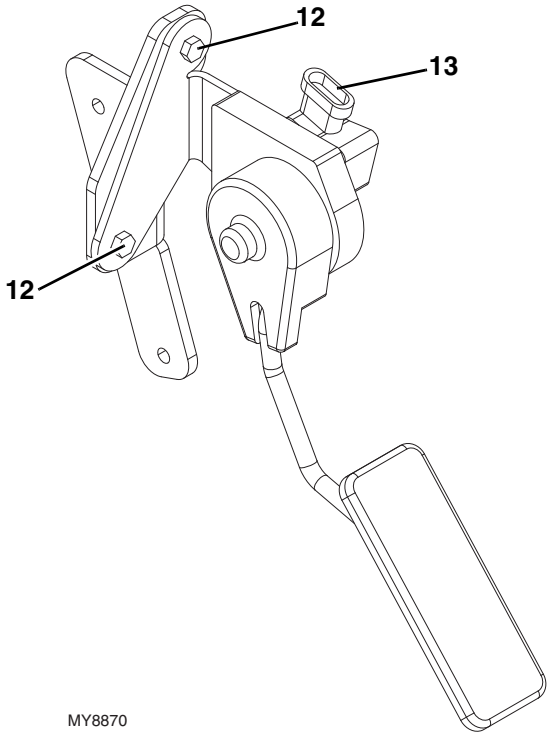
1. Position service brake pedal in its mounting location within cab.
2. Install brake pedal being careful to reposition brake plunger yoke.
3. Install return spring and pin (**11**).
4. Install hardware (**10**) securing pin.
5. Adjust brake pedal as needed.
6. Install and secure lower dash cover.
7. Properly connect battery.
8. Close and secure engine cover.
9. Remove a Do Not Operate Tag on both ignition key switch and steering wheel.



4.4.4 Accelerator Pedal Replacement

a. Accelerator Pedal Removal

1. Park machine on a hard, level surface.
2. Fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL.
3. Engage park brake and shut engine OFF.
4. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
5. Properly disconnect battery.
6. Open engine cover. Allow system fluids to cool.



7. Remove hardware (**12**) securing pedal assembly to cab frame.
8. Disconnect sensor (**13**) from pedal assembly.
9. Remove accelerator pedal assembly from cab.

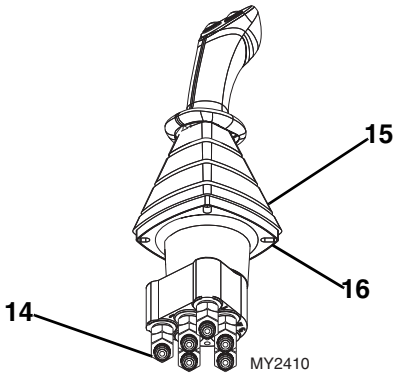
b. Accelerator Pedal Installation

1. Reconnect sensor (**13**) to pedal assembly.
2. Align pedal assembly with its mount holes under cab dash.
3. Install hardware (**12**) securing pedal assembly to mount.
4. Properly connect the battery.
5. Close and secure engine cover.
6. Remove a Do Not Operate Tag on both ignition key switch and steering wheel.

4.4.5 Joystick Replacement

a. Joystick Removal

1. Park machine on a hard, level surface.
2. Fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL.
3. Engage park brake and shut engine OFF.
4. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
5. Properly disconnect battery.
6. Open engine cover. Allow system fluids to cool.
7. Support the boom by installing the lift cylinder lock or a suitable support.



8. Label, disconnect and cap hydraulic hoses and electrical connections (**14**) to joystick.
9. Lift rubber boot (**15**) from base of joystick and remove capscrews (**16**).
10. Remove joystick.

b. Joystick Installation

1. Uncap and reconnect previously labeled hydraulic hoses to their appropriate locations.
2. Reconnect electrical connections.
3. Install capscrews in joystick base.
4. Re-seat rubber boot to joystick base.
5. Remove lift cylinder lock if previously installed.
6. Properly connect battery.
7. Close and secure engine cover.
8. Start engine and test joystick for proper functions.
9. Remove a Do Not Operate Tag on both ignition key switch and steering wheel.

4.4.6 Windshield Wiper Assembly (If Equipped)

Refer to Section 9.8.1, “Windshield Wiper Motor,” for removal and installation information.

4.4.7 Windshield Washer Assembly (If Equipped)

Refer to Section 9.8.3, “Windshield Washer Reservoir and Pump,” for removal and installation information.

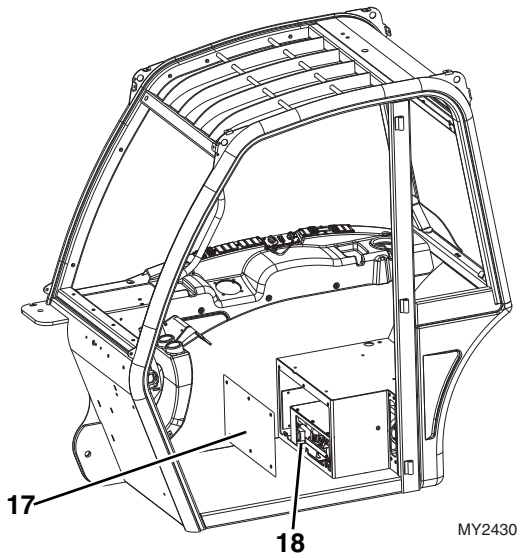
4.4.8 Heater/Air Conditioning System (If Equipped)

a. Removal

1. Park machine on a hard, level surface.
2. Fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL.
3. Engage park brake and shut engine OFF.
4. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
5. Properly disconnect battery.
6. Open engine cover. Allow system fluids to cool.
7. Place a suitable container beneath the radiator petcock
8. Slowly turn the coolant surge tank cap and allow any pressure to escape.
9. Place a funnel at base of radiator to channel drained coolant into container.
10. Open radiator petcock and allow coolant to drain.
11. Close the radiator petcock.
12. Transfer coolant into a suitable, covered container, and label as "Used Coolant".
13. Dispose of used coolant at an approved recycling facility.

Note: *If equipped with Air Conditioning, contact the local JLG dealer or certified air conditioning service center for proper draining of the air conditioner system.*

Note: *Label all hoses to ensure correct installation.*



14. Remove front cover to expose heater/defroster element (**17**).
15. Loosen hose clamps and disconnect the two heater hoses.
16. Remove capscrews, nuts and lockwashers securing heater assembly to cab.
17. Carefully pull out heater assembly (**18**). Label and disconnect wiring harness connections at blower.
18. Remove heater assembly.

b. Installation

1. Install heater assembly (**18**) to original orientation.
2. Connect wiring harness connections at blower.
3. Install capscrews, nuts and lockwashers to secure heater assembly to cab.
4. Reconnect heater hoses.
5. Refill cooling system at recovery tank with a 50/50 mixture of ethylene glycol and water allowing time for coolant to fill engine block. See Section 2.5, “Fluids, Lubricants and Capacities,” for system capacities.

Note: *If equipped with Air Conditioning, contact the local JLG dealer or certified air conditioning service center for proper charging of the air conditioner system. Refer to Section 2.5.2, “Capacities.” for refrigerant type and capacity.*

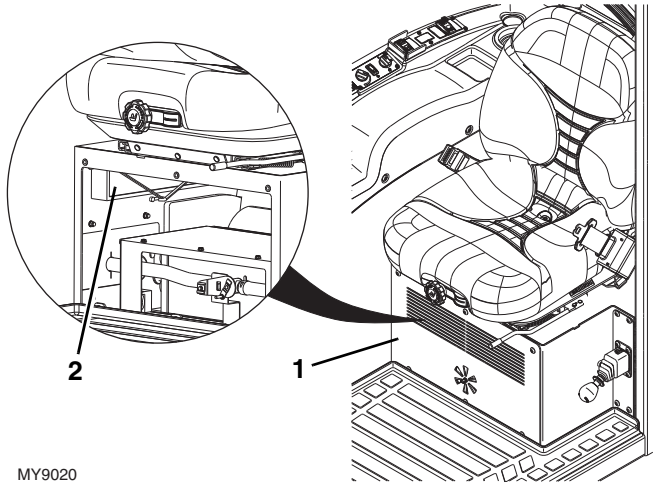
6. Properly connect battery.
7. Start engine, run it briefly at low idle and check machine for any visual sign of fluid leakage. STOP the machine immediately if any leakage is noted, and make any necessary repairs before continuing.
8. Install front cover (**17**) in cab.
9. Check coolant level. Add or remove fluid as required.
10. Close and secure engine cover.
11. Remove a Do Not Operate Tag on both ignition key switch and steering wheel.

4.4.9 Air Conditioning (If Equipped)

If the air conditioning system requires servicing, contact the local JLG dealer or certified air conditioning service center. Refer to Section 2.5.2, “Capacities.” for refrigerant type and capacity.

4.4.10 Air Filter System (If Equipped)

1. Park machine on a hard, level surface.
2. Fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL.
3. Engage park brake and shut engine OFF.
4. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
5. Properly disconnect battery.
6. Open engine cover. Allow system fluids to cool.



7. Remove access panel (**1**).
8. Remove cab air filter (**2**) and inspect. If required, replace with new filter.
9. Place filter back under seat and secure.
10. Replace and secure access panel.
11. Properly connect battery.
12. Close and secure engine cover.
13. Remove a Do Not Operate Tag on both ignition key switch and steering wheel.

4.5 CAB REMOVAL

WARNING

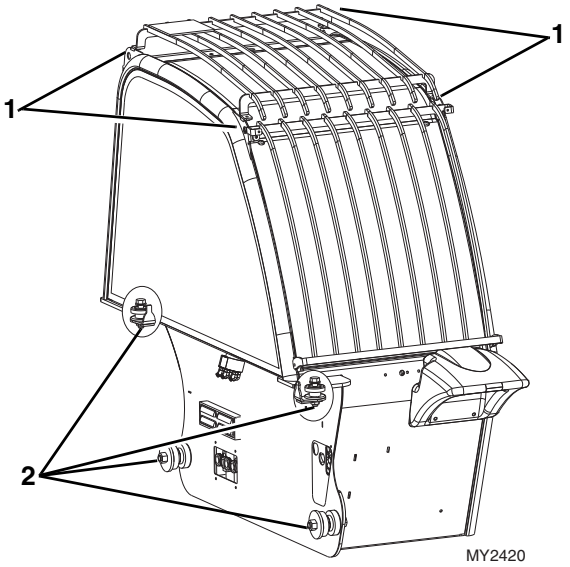
The protection offered by this ROPS/FOPS will be impaired if subjected to any modification or structural damage, at which time replacement is necessary. ROPS/FOPS must be properly installed using fasteners or correct size and grade, and torqued to their specified value.

Note: *To help ensure safety and optimum performance, replace cab if it is damaged. Refer to appropriate parts manual for ordering information.*

Inspect cab, its welds and mounts. If modification, damage, a cracked weld and/or fatigued metal is discovered, replace cab. Contact local **JLG** Dealer with any questions about suitability or condition of a cab.

Note: *Remove and label cab components as needed before removing cab from machine. Label, disconnect and cap hydraulic hoses. Transfer cab parts to replacement cab after replacement cab is securely mounted on machine.*

1. Park machine on a hard, level surface.
2. Fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL.
3. Engage park brake and shut engine OFF.
4. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
5. Properly disconnect battery.
6. Open engine cover. Allow system fluids to cool.
7. If equipped with a cab heater, Refer to Section 4.4.8, b. “Installation.”
8. Working underneath cab, label, disconnect and cap all hydraulic hoses at cab fittings.
9. Cap all fittings and openings to keep dirt & debris from entering hydraulic system.
10. Label and disconnect cab harness connectors. Move harnesses clear of cab to prevent damage during cab removal.
11. Install four lifting eye bolts with a minimal lifting capacity of 800 lb (363 kg) in existing holes at top corners of cab (**1**).
12. Use a hoist or overhead crane and sling with a minimal lifting capacity of 800 lb (363 kg) attached to four lifting eye bolts. DO NOT attempt to lift cab at this point.
13. Remove hardware (**2**), securing cab to frame.



14. Remove mirrors and all other cab components as needed, if not previously removed.
15. When all wiring, hydraulic hoses and fasteners are disconnected or removed, carefully and slowly lift cab and remove it from frame.
16. Readjust position of sling as needed to help balance cab during removal.
17. When cab is completely clear of machine, carefully lower it to ground.
18. Block up or support cab so that it does not move or fall. Assure that no personnel enter cab while it is being removed from machine.
19. Inspect condition of fittings, clamps, hydraulic hoses, etc. Replace parts as indicated by their condition.
20. Inspect and replace other machine parts that are exposed with cab removed. Repair or replace as required.

4.6 CAB INSTALLATION

1. Block all four wheels to help prevent machine from moving. Assure that there is sufficient overhead and side clearance for cab installation.
2. Attach a sling with minimal lifting capacity of 800 lb (363 kg) through previously installed eye bolts.
3. Use a hoist or overhead crane and sling attached to cab. Carefully begin to align cab with mounting holes in frame.
4. Stop and check that wiring, hydraulic hoses, cables, etc., will not be pinched or damaged as cab is positioned. Take special note of fuel fill tube as well.
5. Readjust position of sling as needed to help balance cab during installation.
6. Install cab-to-frame hardware (**2**).
7. Torque upper cab bolts to 340 lb-ft (461 Nm).
8. Torque lower cab bolts to 530 lb-ft (719 Nm).
9. Remove eye bolts from top of cab (**1**).
10. Uncap and reconnect hydraulic hoses at cab locations.
11. Install cab-to-wiring harness connectors on side of the cab.
12. Uncap and connect heater hoses to engine.
13. Secure with hose clamps.
14. If equipped with a cab heater, Refer to Section 4.4.8, “Heater/Air Conditioning System (If Equipped).”
15. Properly connect battery.
16. Carefully examine all cab components, fasteners, etc., one last time before engine start-up. Rectify any faulty conditions.
17. Start engine and check operation of all controls.
18. Check for hydraulic fluid leaks.
19. Check hydraulic fluid level in tank and add fluid as required

NOTICE

When the engine is initially started, run it briefly at low idle and check the machine for any visual sign of fluid leakage. STOP the engine immediately if any leakage is noted, and make any necessary repairs before continuing.

20. If equipped with optional heater, operate engine until operating temperature is achieved ensuring that thermostat has opened.
21. Turn engine off and wait for engine to cool and check coolant level. Add coolant as required to bring coolant to proper level.
22. Install protective cover to front of cab.
23. Install mirrors and all other components as needed, if removed.
24. Unblock wheels
25. Close and secure engine cover.
26. Start engine and test joystick for proper functions.
27. Remove a Do Not Operate Tag on both ignition key switch and steering wheel.

⚠ WARNING

Avoid breathing exhaust fumes, and prevent engine operation from becoming a cause of toxic emissions.

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Section 5
Axles, Drive Shafts, Wheels and Tires

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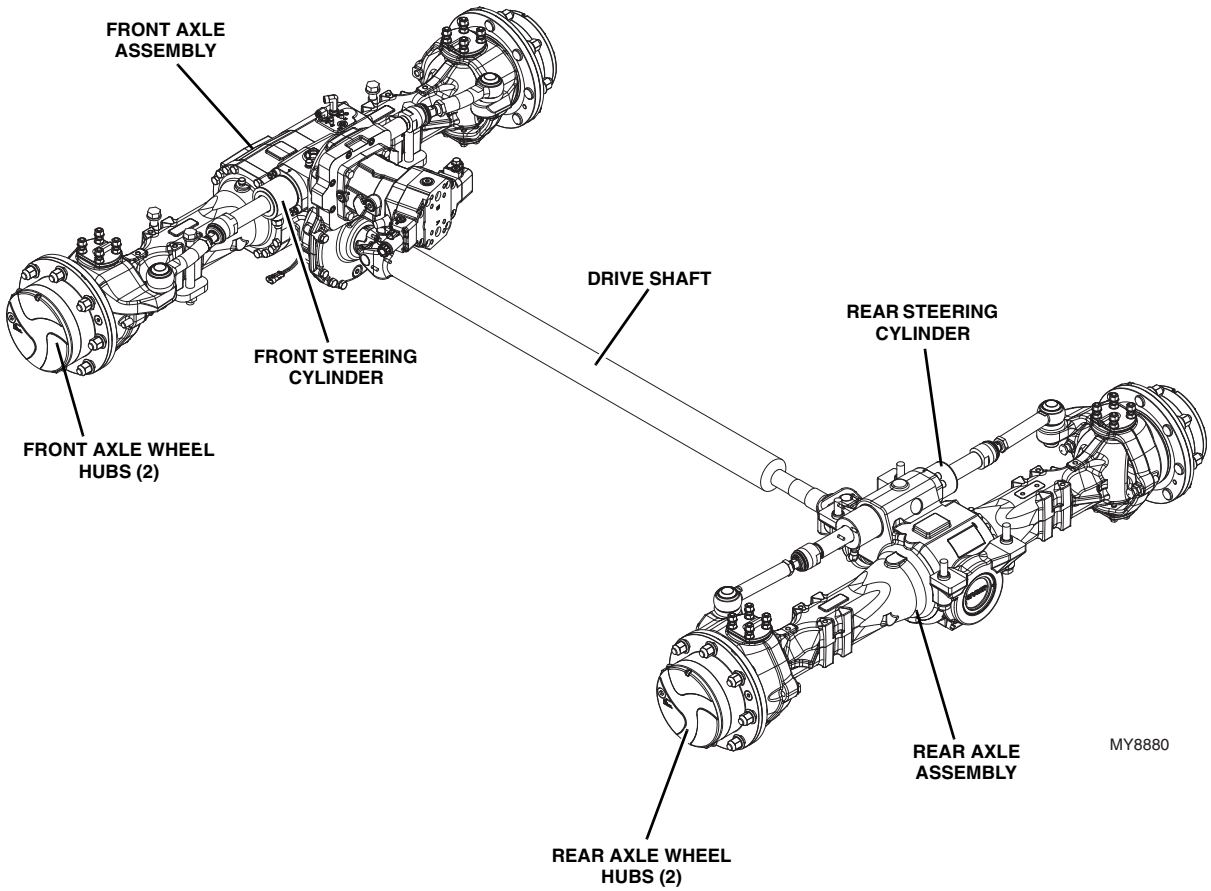
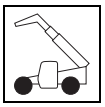
5.1 AXLE, DRIVE SHAFT AND WHEEL COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the axles, drive shafts, wheels and tires. The following illustration identifies the components that are referred to throughout this section.





5.2 SAFETY INFORMATION

⚠ WARNING

DO NOT service the machine without following all safety precautions as outlined in the "Safety Practices" section of this manual.

5.3 GENERAL INFORMATION

Before performing any inspection, maintenance or service operation, thoroughly clean the unit. The axles and drive shafts should be checked and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

Use suitable products to thoroughly clean all disassembled mechanical parts to help prevent personal injury to the worker and prevent damage to the parts. Carefully inspect the integrity of all moving parts (bearings, yokes, tubes, gears, shafts, etc.) and fasteners (nuts, bolts, washers, etc.) as they are subject to major stress and wear.

5.4 AXLE ASSEMBLIES

5.4.1 Axle Serial Number Plate

The front and rear axle serial number plate is located on the inside of each axle on the right side of the center section. Information on the serial number plate is required in correspondence regarding the axle.

Supply information from the axle serial number plate when communicating about an axle assembly or axle components.

5.4.2 Axle Specifications

General axle specifications are found in Section 2, "General Information and Specifications."

5.4.3 Axle Internal Service

Detailed axle service instructions (covering the axle, differential, brakes and wheel-end safety, repair, disassembly, reassembly, adjustment and troubleshooting information) are provided in the following publications:

- Front Axle Manual P/N 31200419
- Rear Axle Manual P/N 31200981

5.4.4 Axle Maintenance

CLEANING: Clean parts with machined or ground surfaces (such as gears, bearings and shafts) with emulsion cleaners or petroleum-based cleaners. **DO NOT** steam clean internal components and the interior of the planetary hub and axle housing. Water can cause corrosion of critical parts. Rust contamination in the lubricant can cause gear and bearing failure. Remove old gasket material from all surfaces.

DRYING: Use clean, lintless towels to dry components after cleaning. **DO NOT** dry bearings by spinning them with compressed air; this can damage mating surfaces due to lack of lubrication. After drying, coat components with oil or a rust-preventive chemical to help protect them from corrosion. If storing components for a prolonged period, wrap them in wax paper.

PERIODIC OPERATION REQUIREMENT: Every two weeks, drive the machine far enough to cause the drive-train components to make several complete revolutions. This will help ensure that internal components receive lubrication to minimize deterioration caused by environmental factors such as high humidity.

SUBMERSION: If the machine has been exposed to water deep enough to cover the hubs, disassemble the wheel ends and inspect for water damage and contamination. If the carrier housing was submerged in water, especially if the water level was above the vent tube (breather), drain the axle and inspect internal parts for water damage and contamination. Before assembling and refilling the unit with the specified lubricant(s), clean, examine and replace damaged parts as necessary.

5.4.5 Axle Removal

⚠ WARNING

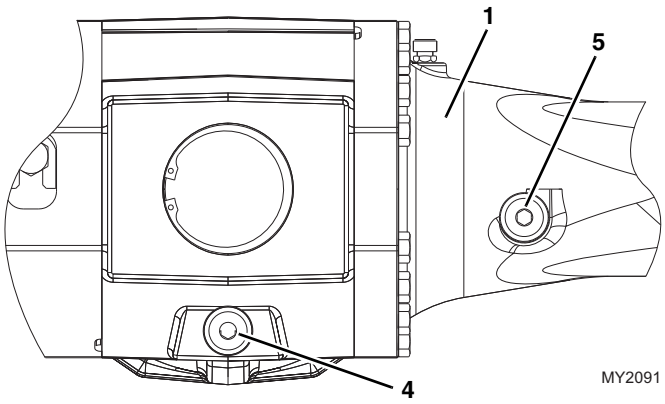
An improperly supported machine can fall, causing death or severe personal injury. Safely raise and adequately support the machine so that it will remain stable and in place before attempting to remove an axle.

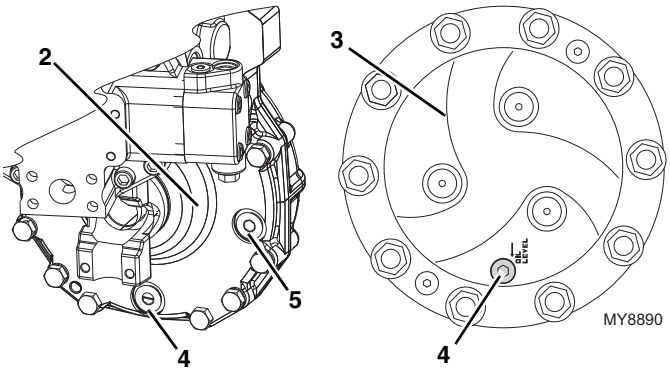
The front and rear axle assemblies differ in that the front axle assembly is equipped with a drop box, hydraulic drive pump, parking brake mechanism and a limited-slip feature; the rear axle has none of these. The following steps outline a typical axle removal procedure, suitable for either the front or the rear axle assembly.

Cleanliness is extremely important. Before attempting to remove the axle, thoroughly clean the machine. Avoid spraying water or cleaning solution on the stabilizer solenoids and other electrical components. If using a steam cleaner, seal all openings before steam cleaning.

Note: *Clear the work area of all debris, unnecessary personnel, etc. Allow sufficient space to raise the machine and to remove the axle.*

1. Park machine on a hard, level surface.
2. Fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL.
3. Engage park brake and shut engine OFF.
4. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
5. Properly disconnect battery.
6. Open engine cover. Allow system fluids to cool.
7. If the axle will be disassembled after removal, the oil will have to be drained. Loosen the breather to release possible internal pressure, then tighten breather with a torque wrench to 9 lb-ft (12 Nm).

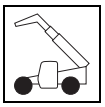




8. If axle will be disassembled after removal, place a suitable receptacle under axle (**1**), drop box (**2**) and wheel hubs (**3**) drain plugs (**4**). Remove drain plugs and allow axle oil to drain into receptacle. Transfer used axle oil into a suitable covered container, and label container as "Used Oil." Dispose of used oil at an approved recycling facility.
9. Label, disconnect and cap steering and brake lines at axle. Wipe up any spilled oil.
10. Block front and rear of both tires on axle that is not being removed. Ensure that machine will remain in place during axle removal before proceeding.
11. Raise machine using a suitable jack or hoist. Place suitable supports under both sides of frame and lower machine onto supports. Ensure that machine will remain in place during axle removal.
12. Support axle that is being removed with a suitable jack, hoist or overhead crane and sling. **DO NOT** raise axle or machine.
13. Mark and remove both wheel and tire assemblies from the axle that is being removed. (Refer to Section 5.6.1, “Removing Wheel and Tire Assembly from Machine.”)

Note: *The wheel and tire assemblies must be re-installed later with the directional tread pattern “arrows” facing in the direction of forward travel.*

14. Remove drive shaft assembly. (Refer to Section 5.5.3, “Drive Shaft Removal.”)
15. Remove capscrews, locknuts and axle plates securing axle to frame.
16. Remove axle from machine using jack, hoist or overhead crane and sling supporting axle. **DO NOT** raise or otherwise disturb machine while removing axle. Balance axle and prevent it from tipping, turning or falling while removing it from beneath machine. Place the axle on a suitable support or holding stand.

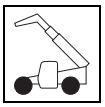


5.4.6 Axle Installation

1. Before proceeding, ensure that the machine will remain in place during axle installation. Block the front and rear of both tires on the axle that is already installed on the machine.
2. If applicable, raise the machine using a suitable jack or hoist. Place suitable supports beneath the frame and lower the machine onto the supports, allowing enough room for axle installation. Ensure that the machine will remain in place during axle installation.
3. Using a suitable jack, hoist or overhead crane and sling, remove the axle from its support or holding stand. Balance the axle and prevent it from tipping, turning or falling while positioning it beneath the machine. **DO NOT** raise or otherwise disturb the machine while installing the axle. Keep the axle supported and balanced on the jack, hoist or overhead crane and sling throughout the installation procedure.
4. Position the axle under the frame, and align with the holes in the frame.
5. Install the axle with capscrews, locknuts and the axle plates. Torque the front and rear axles to 420 lb-ft (569 Nm).
6. Install the drive shaft assemblies. (Refer to Section 5.5.5, “Drive Shaft Installation.”)
7. If reinstalling an axle previously removed from the machine, position the driveshaft yoke on the axle according to the alignment marks made earlier. If installing a new axle, note the position of the driveshaft yoke at the transmission. Align the driveshaft yoke on the axle in the same plane as the yoke on the transmission.
8. Tighten the axle oil drain plug (**4**), loosen and remove the axle oil fill plug (**5**). Tighten the drop box oil drain plug (**4**), loosen and remove the drop box oil fill plug (**5**). Fill axle with the appropriate oil. Refer to Section 2.5, “Fluids, Lubricants and Capacities,” for proper oil and capacities.Rotate wheel hubs 90 degrees so the drain plug (**4**) becomes the fill plug. Fill wheel hubs with the appropriate oil. Refer to Section 2.5, “Fluids, Lubricants and Capacities,” for proper oil and capacities.
9. Install the wheel and tire assemblies. (Refer to Section 5.6.2, “Installing Wheel and Tire Assembly onto Machine.”)
10. Carefully remove the jack, hoist or overhead crane and sling supporting the axle.
11. Carefully raise machine using a suitable jack or hoist. Remove supports from beneath frame and lower machine to ground.
12. Remove blocks from front and rear of both tires on other axle.
13. Uncap and reconnect steering and brake lines at their axle fittings. Refer to Section 8.11.2, “Service Brake Valve,” for brake bleeding procedures.
14. Check hydraulic reservoir oil level.
15. Properly connect battery.
16. Close and secure the engine covers.
17. Start engine. Turn steering wheel several times lock to lock and check function of brakes. Check for hydraulic leaks, and tighten or repair as necessary.
18. Remove a Do Not Operate Tag on both ignition key switch and steering wheel.

5.4.7 Axle Assembly and Drive Shaft Troubleshooting

Problem	Possible Causes	Remedy
1. Excessive axle noise while driving.	1. Oil level too low.	1. Fill oil to correct level. (Refer to Section 2.5, “Fluids, Lubricants and Capacities.”)
	2. Axle and/or wheel end housings filled with incorrect oil or oil level low.	2. Drain axle and/or wheel end housings and fill to correct level. (Refer to Section 2.5, “Fluids, Lubricants and Capacities.”)
	3. Incorrect alignment of ring and pinion gears.	3. Correct alignment by adding or removing shims as needed.
	4. Incorrect pinion (input) shaft bearing preload.	4. Correct bearing preload by adding or removing shims as needed.
	5. Worn or damaged bearings.	5. Replace bearings as needed.
	6. Worn or broken gear teeth.	6. Replace gears as needed.
	7. Contamination in the axle.	7. Drain axle and/or wheel end housings and fill to correct level. (Refer to Section 2.5, “Fluids, Lubricants and Capacities.”)
	8. Axle housing damaged.	8. Replace damaged parts.
2. Intermittent noise when traveling.	1. Universal joint(s) worn or damaged.	1. Repair or replace universal joints as needed.
	2. Differential ring and/or pinion gears damaged.	2. Determine cause and repair as needed.
3. Vibration or intermittent noise when traveling.	1. Drive shaft universal joint(s) assembly incorrectly tightened.	1. Tighten capscrews to correct torque.
	2. Drive shaft universal joint(s) worn or damaged.	2. Repair or replace universal joints as needed.
	3. Drive shaft damaged/ unbalanced.	3. Replace drive shaft as needed.



5.4.7 Axle Assembly and Drive Shaft Troubleshooting (Continued)

Problem	Possible Causes	Remedy
4. Oil leaking from axle (differential housing and/or axle housings).	1. Drain plugs loose and/or o-rings damaged or missing.	1. Replace o-rings as needed and tighten plugs 59 lb-ft (80 Nm).
	2. Hose fittings loose.	2. Tighten fittings.
	3. Axle shaft seal damaged or missing and/or worn or damaged shaft sealing surfaces.	3. Replace seal and/or joint coupling fork shaft (axle shaft).
	4. Input shaft multi-seal ring damaged or missing and/or worn or damaged pinion (input) shaft sealing surfaces.	4. Replace multi-seal ring and/or input shaft. Adjust ring and pinion alignment and bearing preload as described in the Axle Repair Manuals.
	5. Axle casing to brake housing and/or brake housing to differential assembly o-rings and/or seals worn or damaged.	5. Replace o-rings and seals.
	6. Axle housing mounting nuts and capscrews loose.	6. Tighten housing nuts and capscrews to 236 lb-ft (320 Nm).
	7. Differential and/or axle housing(s) damaged.	7. Replace housing(s) as needed.
5. Oil leaking from wheel end housing (planet carrier).	1. Oil level plugs loose and/or o-rings damaged or missing.	1. Replace o-rings as needed and tighten plugs to 59 lb-ft (80 Nm).
	2. O-ring between hub and housing (planet carrier) damaged or missing.	2. Replace o-ring.
	3. Shaft seal damaged or missing and/or worn or damaged shaft sealing surfaces.	3. Replace seal and/or fork joint shaft.
	4. Housing capscrews loose.	4. Tighten housing capscrews to 41 lb-ft (55 Nm).
	5. Housing (planet carrier) damaged.	5. Replace housing (planet carrier).
6. Oil leaking from steering cylinder.	1. Hose fittings loose.	1. Tighten fittings.
	2. Steering cylinder o-rings and/or seals worn or damaged.	2. Replace o-rings and seals.
	3. Piston rod seal worn or damaged.	3. Replace piston rod seal.
	4. Cylinder tube damaged.	4. Replace cylinder tube.

5.4.7 Axle Assembly and Drive Shaft Troubleshooting (Continued)

Problem	Possible Causes	Remedy
7. Axle overheating.	1. Oil level too high.	1. Fill oil to correct level. (Refer to Section 2.5, “Fluids, Lubricants and Capacities.”)
	2. Axle and/or wheel end housings filled with incorrect oil or oil contaminated or oil level low.	2. Drain axle and/or wheel end housing and fill to correct level. (Refer to Section 2.5, “Fluids, Lubricants and Capacities.”)
8. High steering effort required.	1. Steering (hydraulic) system not operating properly.	1. Refer to the appropriate Axle Repair Manual.
	2. Excessive joint housing swivel bearing preload.	2. Correct bearing preload by adding or removing shims as needed.
	3. Worn or damaged swivel bearings.	3. Replace swivel bearings as needed.
9. Slow steering response.	1. Steering (hydraulic) system not operating properly.	1. Refer to the appropriate Axle Repair Manual.
	2. Steering cylinder leaking internally.	2. Repair or replace steering cylinder as needed.
10. Excessive noise when brakes are engaged.	1. Brake discs worn.	1. Check brake discs for wear. Refer to appropriate Axle Repair Manual.
	2. Brake discs damaged.	2. Replace brake discs.
11. Brakes will not engage.	1. Brake (hydraulic) system not operating properly.	1. Refer to the appropriate Axle Repair Manual.
	2. Brake piston o-rings and seals damaged (leaking).	2. Replace o-rings and seals.
12. Brakes will not hold the machine or braking power reduced.	1. Brake discs worn.	1. Check brake discs for wear. Refer to the appropriate Axle Repair Manual.
	2. Brake (hydraulic) system not operating properly.	2. Refer to the appropriate Axle Repair Manual.
	3. Brake piston o-rings and seals damaged (leaking).	3. Replace o-rings and seals.

5.5 DRIVE SHAFTS

5.5.1 Drive Shaft Inspection

Whenever servicing the machine, conduct a visual inspection of the drive shaft and cross and bearing assembly (universal joints, or U-joints). A few moments spent doing this can help prevent further problems and down time later.

Inspect area where the drive shaft flange yoke and slip yoke mount to the drive shaft. Attempt to turn drive shaft in both directions. Look for excessive looseness, missing parts, cracks or other damage. Worn or damaged drive shaft and cross and bearing assembly may cause an excessive amount of vibration or noise.

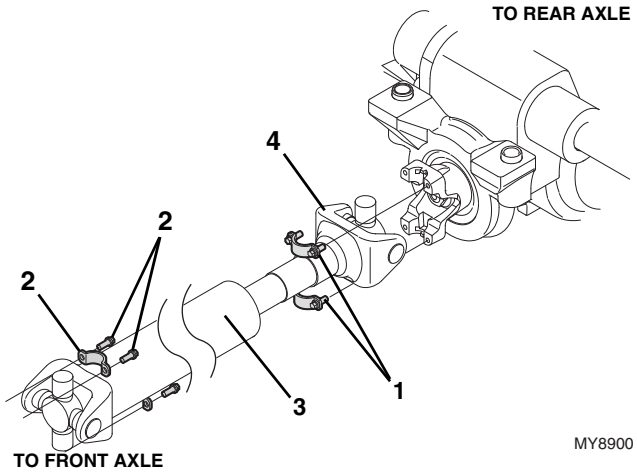
Note: *Any bolt removed from the drive shaft assembly MUST be replaced. Do Not re-torque*

5.5.2 Drive Shaft Maintenance

Refer to Section 2.7, “Lubrication Schedule,” for information regarding the lubrication of the grease fittings on the drive shafts.

5.5.3 Drive Shaft Removal

1. Park machine on a hard, level surface.
2. Fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL.
3. Engage park brake and shut engine OFF.
4. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
5. Properly disconnect battery.
6. Open engine cover. Allow system fluids to cool.
7. Block the wheels.
8. The drive shaft assembly is a balanced assembly. Mark yoke and axle, transmission and shaft and slip yoke so that these components can be returned to their original positions when reinstalled.
9. Yokes at both ends of drive shaft must be in same plane to help prevent excessive vibration.



10. Remove hardware (**1**) securing drive shaft to rear axle flange.
11. Remove hardware (**2**) securing drive shaft to front axle flange.
12. Remove drive shaft assembly (**3**).

5.5.4 Drive Shaft Cleaning and Drying

1. Disassemble and clean all parts. Allow to dry.
2. Remove any burrs or rough spots from all machined surfaces. Re-clean and dry as required.

5.5.5 Drive Shaft Installation

1. Raise drive shaft assembly (**3**) into position. The slip-yoke (**4**) end of drive shaft mounts toward rear axle. If reinstalling a drive shaft previously removed, align flange yokes according to alignment marks made during removal.
2. Apply locking compound to all mounting bolts.
3. Install hardware securing drive shaft to front axle. Torque capscrews to 102 lb-ft (139 Nm).
4. Install hardware securing slip-yoke to rear axle. Torque capscrews to 102 lb-ft (139 Nm).
5. Properly connect the battery.
6. Unblock the wheels.
7. Close and secure the engine covers.
8. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

5.6 WHEELS AND TIRES

⚠ WARNING

Mismatched tire sizes, ply ratings or mixing of tire types (radial tires with bias-ply tires) may compromise machine stability and may cause machine to tip over.

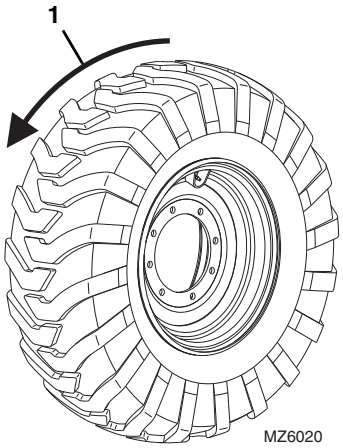
It is recommended that a replacement tire to be the same size, ply and brand as originally installed. Refer to the appropriate parts manual for ordering information. If not using an approved replacement tire, It is recommended that replacement tires have the following characteristics:

- Equal or greater ply/load rating and size of original.
- Tire tread contact width equal or greater than original.
- Wheel diameter, width and offset dimensions equal to the original.
- Approved for the application by the tire manufacturer (including inflation pressure and maximum tire load).

The rims installed have been designed for stability requirements which consist of track width, tire pressure and load capacity. Size changes such as rim width, center piece location, larger or smaller diameter, etc., without written factory recommendations, may result in unsafe condition regarding stability.

Foam filled tires have a positive effect on the weight, stability and handling characteristics of the machine, especially under load. The use of hydrofill as a tire-fill substance is not recommended because of possible environmental impact.

Large-bore valve stems are used to help expedite tire inflation and deflation. An inner tube may be used if a tire does not provide an airtight seal. Check tire inflation pressures when the tires are cold. When mounting a tire on the wheel, the tire must be mounted on the wheel respective of the directional tread pattern of the tire; this produces a left or right tire and wheel assembly.



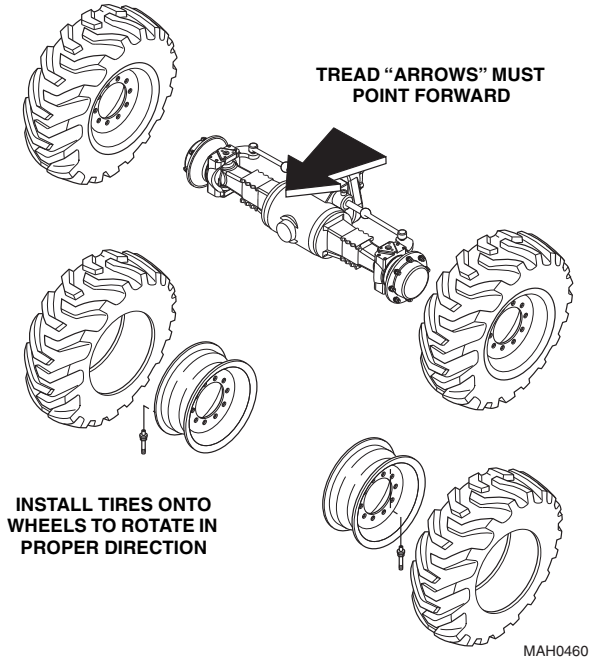
The wheel and tire assemblies must be installed with the directional tread pattern “arrows” (**1**) facing in the direction of forward travel.

5.6.1 Removing Wheel and Tire Assembly from Machine

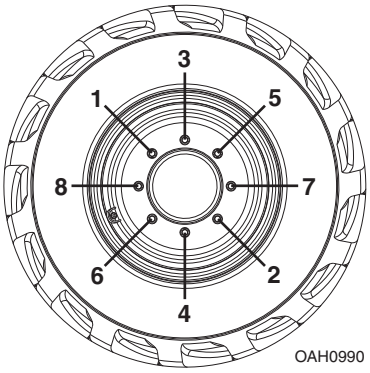
1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Loosen but **DO NOT** remove the lug nuts on the wheel and tire assembly to be removed.
4. Place a suitable jack under the axle pad closest to the wheel being removed. Raise the machine and position a suitable support beneath the axle. Allow sufficient room to lower the machine onto the support and to remove the wheel and tire assembly.
5. Lower the machine onto the support.
6. Remove lug nuts and washers in an alternating pattern.
7. Remove the wheel and tire assembly from the machine.

5.6.2 Installing Wheel and Tire Assembly onto Machine

Note: *The wheel and tire assemblies must be installed with the directional tread pattern "arrows" facing in the direction of forward travel.*



1. Position wheel onto studs on wheel end of axle.
2. Install washers on the wheel studs.
3. Start all lug nuts by hand to prevent cross threading. DO NOT use a lubricant on threads or nuts.



4. Tighten lug nuts in an alternating pattern as indicated in figure. Torque to 221 lb-ft (300 Nm).
5. Remove machine from supports.
6. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

5.7 STEERING ANGLE ADJUSTMENT

Detailed axle service instructions are provided in the Axle Disassembly & Assembly Manual (P/N 31200451).

5.8 BRAKES

5.8.1 Brake Disc Inspection

Detailed axle service instructions are provided in the Front Axle Disassembly & Assembly Manual (P/N 31200419).

5.9 TOWING A DISABLED MACHINE

Towing a disabled machine should only be attempted after exhausting all other options. Make every effort to repair the machine, and move it under its own power.

Towing is only possible by using the “towing” feature built into hydrostatic pump and disengaging park brake on the front axle.

- **Maximum** towing distance is 200 ft (60 m).
- **Maximum** towing speed is 5 mph (8 kmh).
- **Maximum** towing grade is 25%.

DO NOT attempt to tow a machine that is loaded or boom/attachment is raised above 1,2 m (4 ft).

⚠ WARNING

MACHINE HAS NO TOWING BRAKES. Towing vehicle must be able to control machine at all times. On highway towing is NOT permitted.

⚠ WARNING

BLOCK ALL FOUR WHEELS TO PREVENT MACHINE FROM MACHINE ROLL AWAY. Failure to follow instructions could cause death or serious injury.

5.9.1 Equipment and Supplies Required

NOTICE

EQUIPMENT DAMAGE. Auxiliary Hydraulic Power Supply hydraulic oil must be compatible with hydraulic oil shown in Section 2.5, “Fluids, Lubricants and Capacities.”

Auxiliary Hydraulic Power Supply:

- Portable hydraulic unit with capability of producing 300 psi (20,7 bar) minimum pressure to release park brake.

Hose:

- One Hydraulic Hose–Approximately 5 ft (1,5 m), with a minimum I.D. of 0.25 in (6,3 mm) and a minimum rating of 250 psi (17 bar).

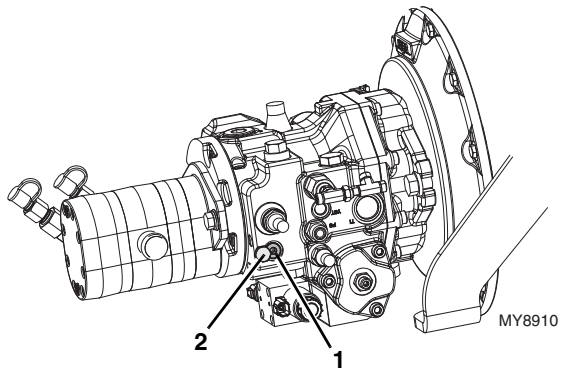
Fittings:

- One 9/16-18 UNF (-6) ORFS Cap
- One 9/16-18 UNF (-6) ORFS Plug

Note: *Machine axle fittings are* 9/16-18 UNF (-6) ORFS*. The adaptor size may vary depending on the hose end of the auxiliary hydraulic power supply.*

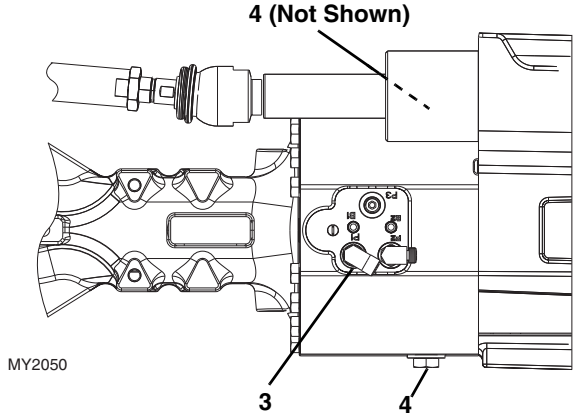
5.9.2 Towing Procedure

1. Securely block all four wheels.



2. Loosen shuttle valve (**1**) on hydrostatic transmission until it hits against stop (**2**).

Note: *This procedure does not alter any relief settings.*



3. Connect an auxiliary hydraulic power supply to P1 port (**3**) on front axle and apply 220-435 psi (15-30 bar) to release the park brake.

Note: *DO NOT apply more than 450 psi (31 bar) to release the park brake. Excessive pressure could damage the axle brake system.*

4. Loosen unlocking bolts (**4**) located at front and back side of axle housing and remove stop washers.
5. Tighten unlocking bolts against axle housing.
6. Release pressure from auxiliary hydraulic power supply and remove auxiliary hydraulic power supply
7. Carefully remove blocking from each tire and tow machine to a secure location.
8. After machine has been towed to a secure location, block all four wheels.
9. Tighten relief valve (**1**) on hydrostatic transmission to 32-41 lb-ft (44-56 Nm).
10. Connect an auxiliary hydraulic power supply to the P1 port (**2**) on the front axle and apply 220-435 psi (15-30 bar) to release the park brake.

Note: *DO NOT apply more than 450 psi (31 bar) to release the park brake. Excessive pressure could damage the axle brake system.*

11. Loosen unlocking bolts (**4**) and install stop washers.
12. Tighten unlocking bolts 70-85 lb-ft (95-115 Nm).
13. Release pressure from auxiliary hydraulic power supply and remove auxiliary hydraulic power supply.
14. The parking brake should now be reactivated and front wheels locked.
15. Remove blocks from four tires.
16. Verify that parking brake works.
17. If parking brake does not work, check all activation operations step by step.

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Section 6
Transmission

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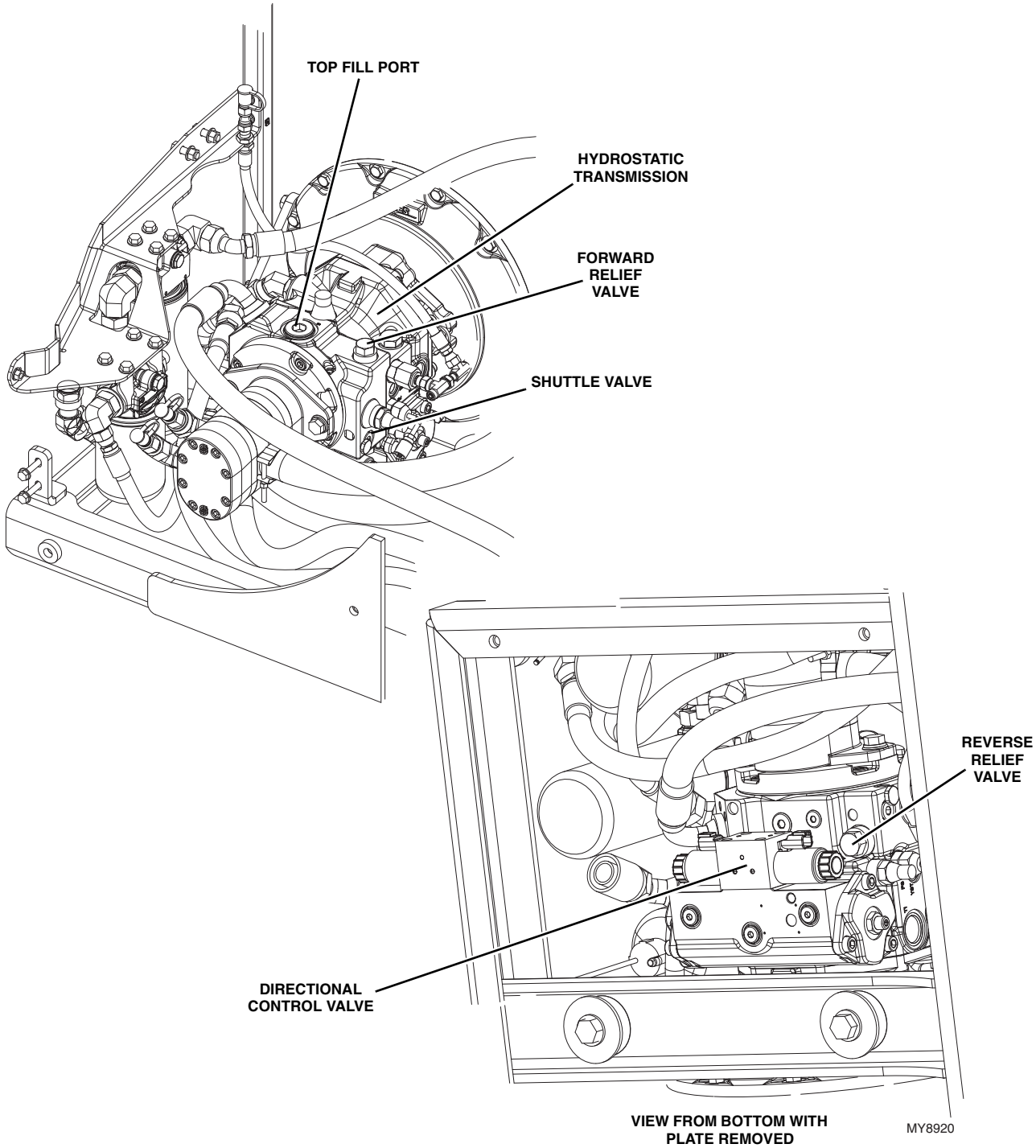
6.1 TRANSMISSION ASSEMBLY COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the transmission. The following illustration identifies the components that are referred to throughout this section.



6.2 SAFETY INFORMATION

WARNING

DO NOT service the machine without following all safety precautions as outlined in the “Safety Practices” section of this manual.

6.3 TRANSMISSION DESCRIPTION

Instructions in this section pertain mainly to general specifications, towing, maintenance information, and transmission removal and installation procedures. For internal transmission service instructions and detailed specifications contact an authorized Rexroth Repair center.

More information can be obtained from the serial number plate directly mounted on the transmission. Information specified on the serial number plate includes the transmission model number, the transmission serial number and other data. Information on the serial number plate is required in correspondence regarding the transmission.

6.4 TRANSMISSION SPECIFICATIONS

6.4.1 Transmission Maintenance

The transmission is a hydraulic component and requires the same maintenance as the hydraulic system. Refer to Section 2.6, “Maintenance Schedule.”

Performance criteria is based on full throttle engine speed unless otherwise specified or not applicable.

6.5 TRANSMISSION REPLACEMENT

Note: *Contact the local **JLG** Dealer if internal transmission repair is required during warranty period.*

Cleanliness is of extreme importance. Before attempting to remove the transmission, thoroughly clean the exterior of the transmission to help prevent dirt from entering during the replacement process. Avoid spraying water or cleaning solution onto or near the transmission shift solenoids and other electrical components.

6.5.1 Transmission Removal

1. Park machine on a hard, level surface.
2. Fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL.
3. Engage park brake and shut engine OFF.
4. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
5. Properly disconnect battery.
6. Open engine cover. Allow system fluids to cool.
7. Remove the air cleaner assembly.
8. Remove cooling system, Refer to Section 7.2, “Engine Cooling System.”
9. Drain the hydraulic oil reservoir. Refer to Section 8.8.2, “Hydraulic Oil Reservoir Draining.”
10. Label, disconnect and cap all hydraulic hoses attached to transmission and implement pump.
11. Cap all fittings and openings to keep dirt and debris from entering hydraulic system.
12. Remove front fender support bar.
13. Label and disconnect all electrical connections attached to transmission.
14. Wipe up any spilled hydraulic oil.

15. Vertically secure transmission and implement pump with a lifting strap or chain. Use a suitable hoist or overhead crane. Operate hoist or crane to remove slack from chain, but **DO NOT** raise transmission at this time.
16. Remove two bolts that attach transmission to engine.

⚠ WARNING

The transmission may move while hoisting it out of the chassis. Carefully move the transmission and adjust the sling as needed. Keep fingers, hands, legs and other body parts clear of the transmission.

17. Carefully remove transmission and pump from the machine. Avoid causing damage to transmission or surrounding parts.
18. Lift transmission and pump clear of machine, and lower it onto suitable supports or secure it to a stand built especially for transmission or engine service. Secure transmission and pump so that it will not move or fall.

6.5.2 Transmission Disassembly

Contact an authorized Rexroth Repair center for transmission disassembly, internal inspection, service, repair and assembly procedures.

6.5.3 Transmission Installation

⚠ WARNING

NEVER lift a transmission alone; enlist the help of at least one assistant or use a suitable hoist or overhead crane and sling. Failure to follow the safety practices could result in death or serious injury.

1. Use a lifting strap or chain attached to a hoist or overhead crane to position transmission and pump within the chassis.
2. Insert the two bolts that attach transmission to engine. Torque to 154 lb-ft (210 Nm).
3. Remove hoist or overhead crane and sling.
4. Uncap and reconnect previously labeled hoses and electrical connections to their appropriate locations.
5. Remove fill port screw and pre-fill transmission to top of fill port. Install screw and torque to 398 lb-ft (540 Nm).
6. Install front fender support bar.
7. Install cooling system. Refer to Section 7.2, “Engine Cooling System.”
8. Fill hydraulic reservoir with clean, fresh oil and bleed system. **DO NOT** overfill.
9. Properly connect battery.
10. Check hydraulic oil level and add oil as required.

NOTICE

DO NOT use flushing compounds for cleaning purposes.

11. Run engine for two minutes at idle to help bleed any air from hydraulic system.
12. Operate all boom functions to ensure any air is removed from hydraulic system.
13. Retract and level boom, recheck level of the fluid in the reservoir.
14. Add oil as necessary to bring fluid level up until it reaches FULL mark on reservoir. Recheck oil level when it reaches operating temperature 180–200° F (83–94° C).
15. Recheck all drain plugs, lines, connections, etc., for leaks, and tighten where necessary.
16. Close and secure the engine covers.
17. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

Section 7
Engine

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7.1 INTRODUCTION

WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, “Safety Practices,” of this manual.

WARNING

Engine fuel lines are pressurized. **DO NOT** attempt repairs unless specific training has been completed.

7.1.1 Disclaimer and Scope

These instructions are written for worldwide use. In territories where legal requirements govern engine smoke emission, noise, safety factors, etc., apply all instructions, data and dimensions provided herein in such a way that after maintenance, service and repair of the engine, engine operation does not violate local regulations.

Note: *Detailed engine service instructions (covering disassembly, inspection, internal repair, assembly, adjustment and troubleshooting information) are provided in appropriate engine service manual.*
A gradual running-in (break-in) of a new engine is not necessary. Full load can be applied to a new engine as soon as the engine is put into service and the coolant temperature is at least 140° F (60° C). Extended light-load operation during the early life of the engine is not recommended. ***DO NOT*** *run the engine at high, no-load speeds.* ***DO NOT*** *apply an overload to the engine.*

7.1.2 Engine Serial Number

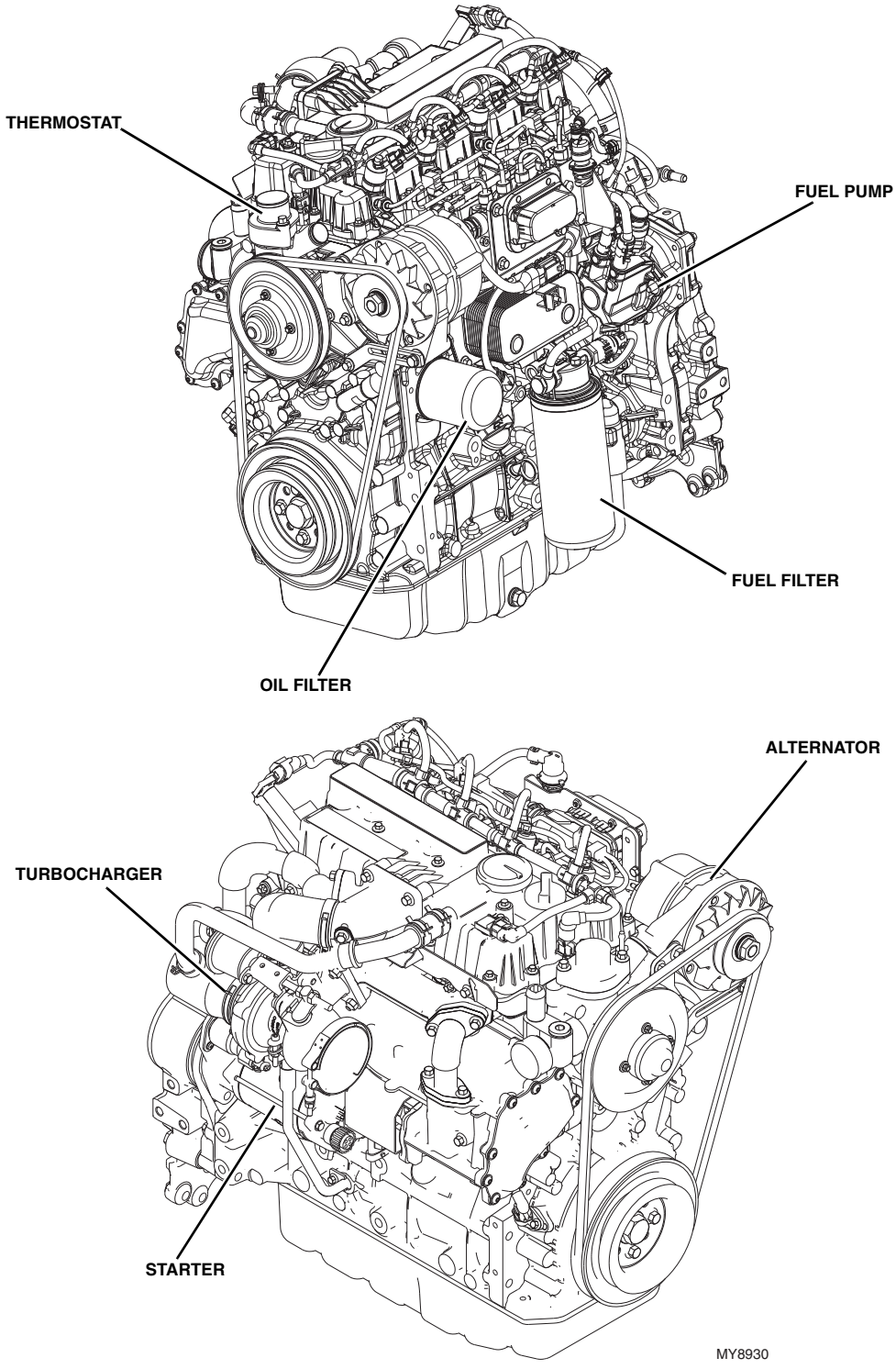
The engine serial number is located on a tag on top of the engine. Information contained in the serial number is required in correspondence with the engine manufacturer.

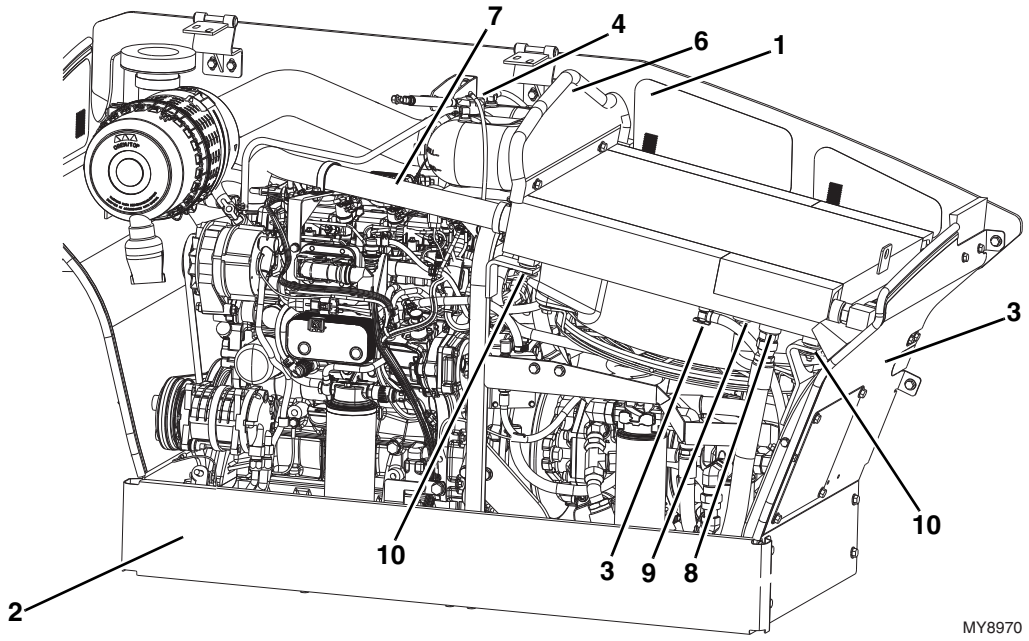
7.1.3 Specifications and Maintenance Information

For engine, coolant and oil specifications, and maintenance information, refer to Section 2, “General Information and Specifications.”

7.1.4 Component Terminology

To understand safety, operation and maintenance information presented in this section, it is necessary that operator/mechanic be familiar with names and locations of engine components. The following illustration identifies components that are referred to throughout this section.





7.2 ENGINE COOLING SYSTEM

7.2.1 Surge Tank Cap

A 14.5 psi (1,0 Bar) cap is used on the surge tank. An incorrect or malfunctioning cap can result in the loss of coolant and a hot-running engine.

7.2.2 Radiator/Oil Cooler Replacement

Before considering radiator or oil cooler replacement for other than obvious damage, conduct a cooling system pressure test check the coolant specific gravity, coolant level, fan belt tension and dash panel temperature indicator.

- If the engine runs hot, check the temperature of the upper radiator hose.
- If the hose is not hot, the thermostat may be stuck in the closed position.
- If the engine has overheated, performance may suffer, indicating other damage including a leaking cylinder head gasket, cracked cylinder head or block, and/or other internal engine damage.

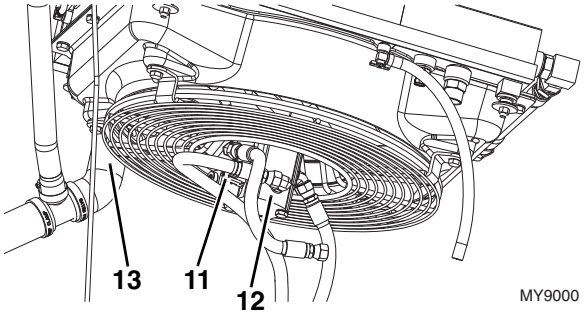
a. Radiator/Oil Cooler Removal

1. Park the machine on a firm, level surface, fully retract the boom, raise and support the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Thoroughly clean the engine and surrounding area, including all hoses and fittings before proceeding.
5. Open the battery cover.
6. Properly disconnect the battery.
7. Support or secure the hood assembly.
8. Remove the mounting nuts from the rod end of each hood gas strut.
9. Remove the two bolts and washers securing each hinge from the hood side of the hood. Mark each bolt location before removing to aid in aligning the hood during reassembly.
10. Remove the hood assembly.
11. Remove the inside firewall plate (**1**) to access the back side of the cooling package.
12. Remove the engine pod side skirt (**2**) and belly pan.
13. Disconnect the ECM connectors and remove any nylon ties that may be securing the wire harness mounted to the right front fender.
14. Remove the right front fender (**3**).

Note: *It may be required to remove the right front tire to access hydraulic hose fittings.*

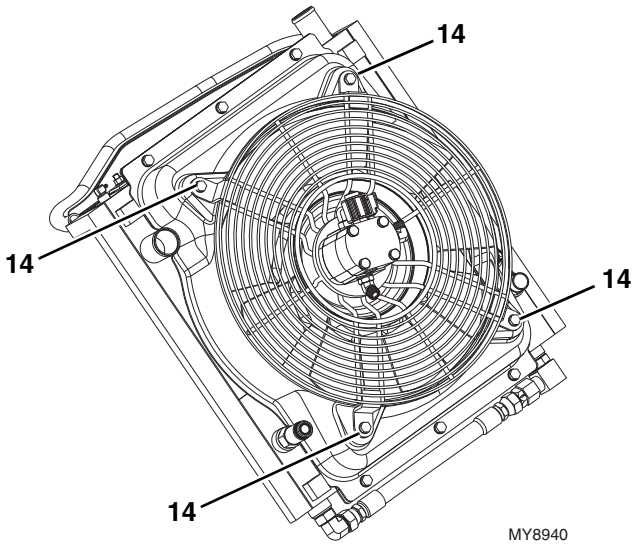
15. Slowly turn the coolant surge tank cap and allow any pressure to escape (**4**).
16. Place a suitable container beneath the radiator petcock (**5**).

17. Place a funnel at the base of the radiator to channel the drained coolant into the container. Open the radiator petcock and drain the coolant into the funnel. Transfer the fluid into a properly labeled container. Dispose of properly if coolant needs to be replaced. Close the radiator petcock.
18. Remove air dam (**6**) to gain access to the cooling package lifting eye mounts.
19. Loosen the mounting bolts and move the surge tank (**4**) to access the cooling package lifting eye mounts.
20. Remove the top radiator hose (**7**) and hose from the surge tank attached to the radiator. Cap all fittings and openings to keep dirt & debris from entering the cooling system.
21. Place a suitable container beneath the hydraulic oil cooler fittings. Transfer any hydraulic oil into a properly labeled container. Dispose of properly.
22. Disconnect and cap the hydraulic hose (**8**) attached to the radiator/oil cooler assembly. Allow hydraulic oil to drain from the hydraulic oil cooler. Cap all fittings and openings to keep dirt & debris from entering the hydraulic system.
23. Disconnect the hydraulic cooler temperature sensor (**9**).
24. Loosen and remove the four mounting nuts and rebound washers (**9**) from the radiator assembly.
25. Connect a lifting strap to the radiator/oil cooler assembly lifting eyes.
26. Slowly lift the radiator assembly to gain access to the fan side, hydraulic oil cooler out hose connections and the bottom radiator hose.

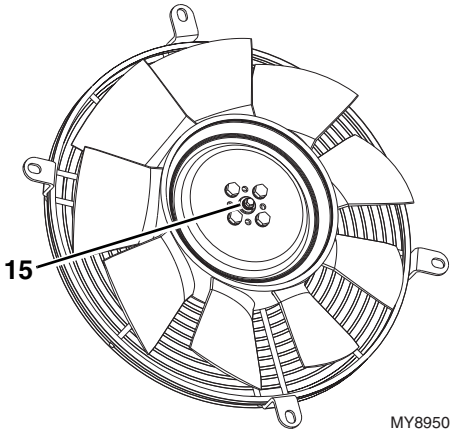


27. Disconnect the connector on the fan solenoid(s). Loosen and remove the fan solenoid(s) (**11**).
28. Label, disconnect and cap the three hydraulic hoses attached to the fan motor (**12**). Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
29. Loosen and remove the lower hydraulic oil cooler hose. Cap all fittings and openings to keep dirt & debris from entering the hydraulic system.
30. Remove the bottom radiator hose (**13**). Cap all fittings and openings to keep dirt & debris from entering the cooling system.
31. Slowly remove the radiator/oil cooler from the machine.

b. Cooler/Fan Motor Removal

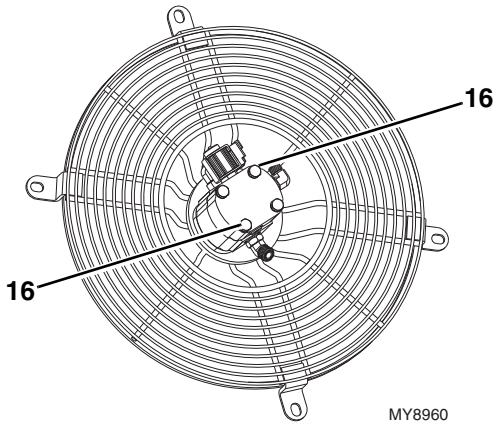


1. Turn the radiator/cooler assembly over and place on a secure location.
2. Remove the four bolts (**14**) securing the fan motor/ guard to the radiator/cooler shroud.



3. Turn the fan motor/guard over to access the fan assembly.
4. Loosen and remove the center bolt and washer (**15**) securing the fan to the motor shaft.

Note: *Retain the key located on the fan motor shaft.*



5. Turn the fan motor/guard over to access the two fan motor mounting bolts (**16**).
6. Loosen and remove both mounting bolts securing the fan motor to the fan guard.
7. Remove the fan motor as necessary.

c. Cooler/Fan Motor Installation

1. Apply Loctite® 242™ to all mounting bolts
2. Install the fan motor to the fan guard. The fan motor can only be installed one way.
3. Install the two previously removed mounting bolts and torque to 31-35 lb-ft (41-47 Nm).
4. Verify the key is in place on the fan motor shaft and install the previously removed fan. Install the fan mounting washer and bolt. Torque to 10.75 lb-ft (15 Nm).
5. Install the fan motor assembly to the fan shroud. Install and torque the mounting bolts to 27 lb-ft (37 Nm).

d. Radiator/Oil Cooler Installation

1. Connect a lifting strap to the radiator/oil cooler lifting eyes.
2. Slowly lower the radiator assembly to connect the previously removed hydraulic fan hoses, hydraulic oil cooler out hoses and the bottom radiator hose.
3. Remove any caps and/or plugs and install the previously removed hoses.
4. Install the previously removed fan solenoid(s).

Note: *Verify the fan solenoid(s) retaining nut is installed with the recess FACING the solenoid.*

5. Lower the radiator/oil cooler assembly into place.
6. Remove any caps and/or plugs and install the previously removed hydraulic cooler outlet hose.
7. Install previously removed bottom radiator hose.
8. Connect the electrical connector to the fan solenoid(s).
9. Connect the electrical connector to the hydraulic temperature sensor.
10. Install the previously removed rebound washers and nuts securing the radiator assembly. Torque the mounting nuts to 31-34 lb-ft (23-25 Nm).
11. Install the previously removed surge tank.
12. Install the previously removed top radiator hose.
13. Connect the previously removed surge tank hose to the radiator.
14. Re-fill the surge tank/radiator with approximately 2.7 gal (9.9 L) of a 50/50 mixture of ethylene glycol and water.
15. Install the previously removed air dam.
16. Install the previously removed inside firewall plate.
17. Install the previously removed right front fender. Do not tighten mounting bolts at this time.
18. Connect the ECM connectors and secure the wire harness.
19. Properly connect the battery.
20. Remove any boom support.
21. Run the engine to operating temperature. Visually check for leaks with the engine running. Check the coolant level in the surge tank and fill, or drain, as necessary. Check the hydraulic oil level in the tank and add hydraulic oil as required.

Note: *Refer to Section 8.11.11, "Variable Speed Fan Valve,"for detailed testing information.*

22. Retract and raise boom. Install previously removed boom support. Shut engine OFF.

Note: *If previously removed, install the right front tire and torque lug nuts to 220 lb-ft (300 Nm).*

23. Install the previously removed engine pod side skirt and belly pan. Tighten all mounting bolts, including the right front fender mounting bolts.
24. Install the hood and secure with the previously removed mounting bolts.
25. Install each gas strut and secure with the previously removed mounting nuts.
26. Adjust hood as needed.
27. Close and secure the engine cover.

28. Install and secure the battery cover.
29. Remove previously installed boom support.
30. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

7.3 ENGINE ELECTRICAL SYSTEM

The engine electrical system, including the starter, alternator and primary wiring, is described in Section 9, “Electrical System.”

7.4 FUEL SYSTEM

7.4.1 Diesel Fuel

Fuel represents a major portion of machine operating costs and therefore must be used efficiently. ALWAYS use a premium brand of high-quality, clean diesel fuel. Low cost, inferior fuel can lead to poor performance and expensive engine repair.

Note: *Use only diesel fuel designed for diesel engines. Some heating fuels contain harmful chemicals that can seriously affect engine efficiency and performance.*

Note: *Due to the precise tolerances of diesel injection systems, keep the fuel clean, and free of dirt and water. Dirt and water in the fuel system can cause severe damage to both the injection pump and the injection nozzles. Use ASTM #2 diesel fuel with a minimum Cetane rating of 40. #2 diesel fuel gives the best economy and performance under most operating conditions. Fuels with Cetane numbers higher than 40 may be needed in high altitudes or extremely low ambient temperatures to help prevent misfiring and excessive smoking.*

Inform the owner/operator of the machine to use #2 diesel fuel, unless ambient temperatures are below 32° F (0° C). When temperatures are below 32° F (0° C), a blend of #1 diesel and #2 diesel fuels (known as “winterized” #2 diesel) may be used.

Note: *#1 diesel fuel may be used, however, fuel economy will be reduced.*

If equipped for ULS, use ultra low-sulfur content fuel with a cloud point (temperature at which wax crystals form in diesel fuel) at least 10° below lowest expected fuel temperature. Viscosity of fuel must be kept above 1.3 centistrokes to provide adequate fuel system lubrication.

If equipped for LS, use low-sulfur content fuel with a cloud point (temperature at which wax crystals form in diesel fuel) at least 10° below lowest expected fuel temperature. Viscosity of fuel must be kept above 1.3 centistrokes to provide adequate fuel system lubrication.

7.4.2 Fuel/Hydraulic Oil Tank

a. Cleaning and Drying

If contaminated fuel, hydraulic oil or foreign material is in the tank, the tank can usually be cleaned.

b. If a leak is suspected between the fuel and hydraulic oil tank, contact the local **JLG** dealer.

To clean the fuel/hydraulic oil tank:

1. Have a dry chemical (Class B) fire extinguisher near the work area.
2. Depending on which side of the tank is contaminated (fuel or hydraulic oil), remove the fuel or oil tank drain plug, and safely drain any fuel or hydraulic oil into a suitable container. Dispose of fuel or hydraulic oil properly.
3. Clean the fuel/hydraulic oil tank with a high-pressure washer, or flush the tank with hot water for five minutes and drain the water. Dispose of contaminated water properly.
4. For the fuel tank side, add a diesel fuel emulsifying agent to the tank. Refer to the manufacturer's instructions for the correct emulsifying agent-to-water mixture ratio. Refill the tank with water, and agitate the mixture for 10 minutes. Drain the tank completely. Dispose of contaminated water properly.
5. Refill the fuel tank with water until it overflows. Completely flush the tank with water. Empty the fuel tank, and allow it to dry completely.

c. Inspection

Note: *If a leak is suspected between the fuel and hydraulic oil tank, contact the local* ***JLG*** *dealer.*

1. Inspect the fuel/hydraulic oil tank thoroughly for any cracks, slices, leaks or other damage.
2. Plug all openings except one elbow fitting. Install the elbow fitting, and apply approximately 1-1.5 psi (0.07-0.10 bar) of air pressure through the elbow. Check the tank for leaks by applying a soap solution to the exterior and look for bubbles to appear at the cracked or damaged area.

d. Disassembly and Assembly

The fuel/hydraulic oil reservoir is a one piece-unit integral to the chassis frame and cannot be disassembled.

7.4.3 After Fuel System Service

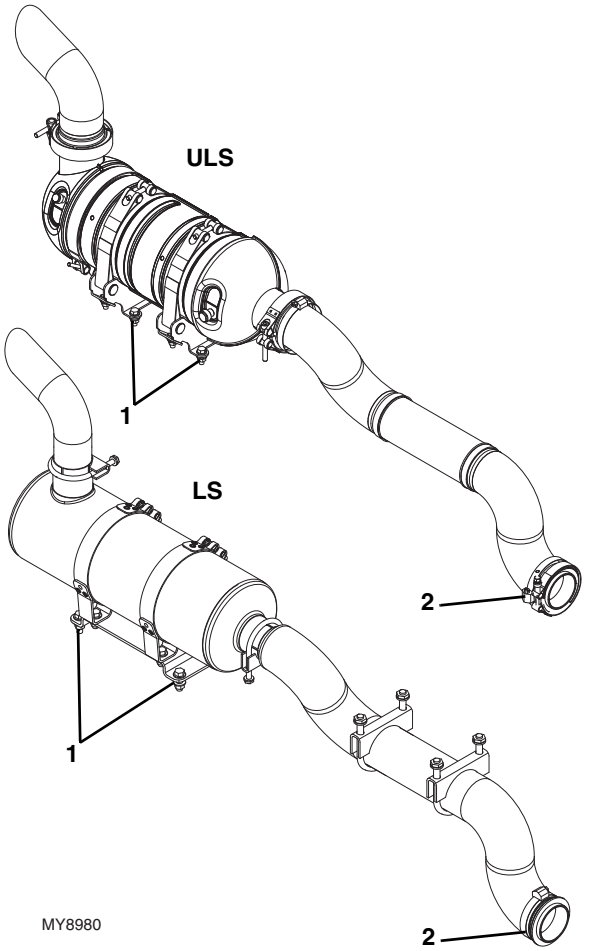
1. Drain and flush the fuel tank if it was contaminated.
2. Fill the fuel tank with fresh, clean diesel fuel as required.

Note: *If bleeding of the fuel system is required, contact the local* ***JLG*** *dealer.*

7.5 ENGINE EXHAUST SYSTEM

7.5.1 Exhaust System Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Loosen and remove the bolts (**1**) connecting the muffler bracket to the frame brackets on the side of the frame.
6. Loosen and remove the exhaust pipe flange nuts (**2**) at the turbocharger.
7. Remove the exhaust system as an assembly.

7.5.2 Exhaust System Installation

Note: *Keep all clamps loosened until entire exhaust system is in place.*

Note: *Replace the nuts and the exhaust studs on the turbocharger if damaged.*

1. Install the exhaust assembly in place at the turbocharger with the previously used hardware. Torque the flange nuts (**2**) on the turbo charger to 22 ±5 lb-ft (30 ±7 Nm).
2. Install the muffler brackets (**1**) to the frame brackets with the previously used hardware.
3. Adjust the muffler, exhaust and tail pipes for proper clearance then tighten all clamps.
4. Properly connect the battery.
5. Start engine and check for exhaust leaks at all exhaust connections. Adjust or repair as needed.
6. Close and secure the engine cover.
7. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

7.6 AIR CLEANER ASSEMBLY

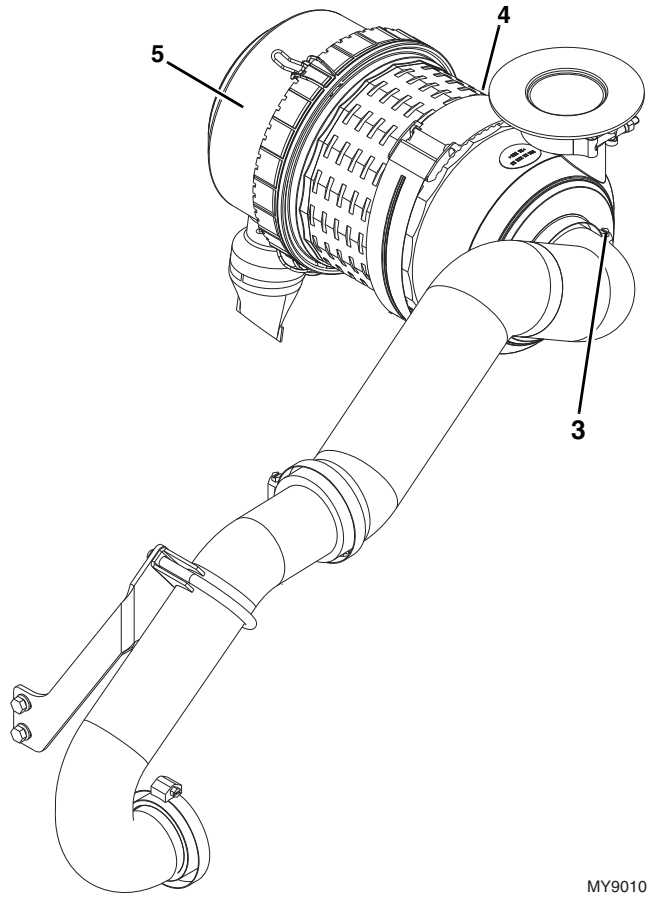
CAUTION

NEVER run the engine with only the inner safety element installed.

Note: *Refer to the machine Operation & Safety Manual for the correct element change procedure.*

7.6.1 Air Cleaner Assembly Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.

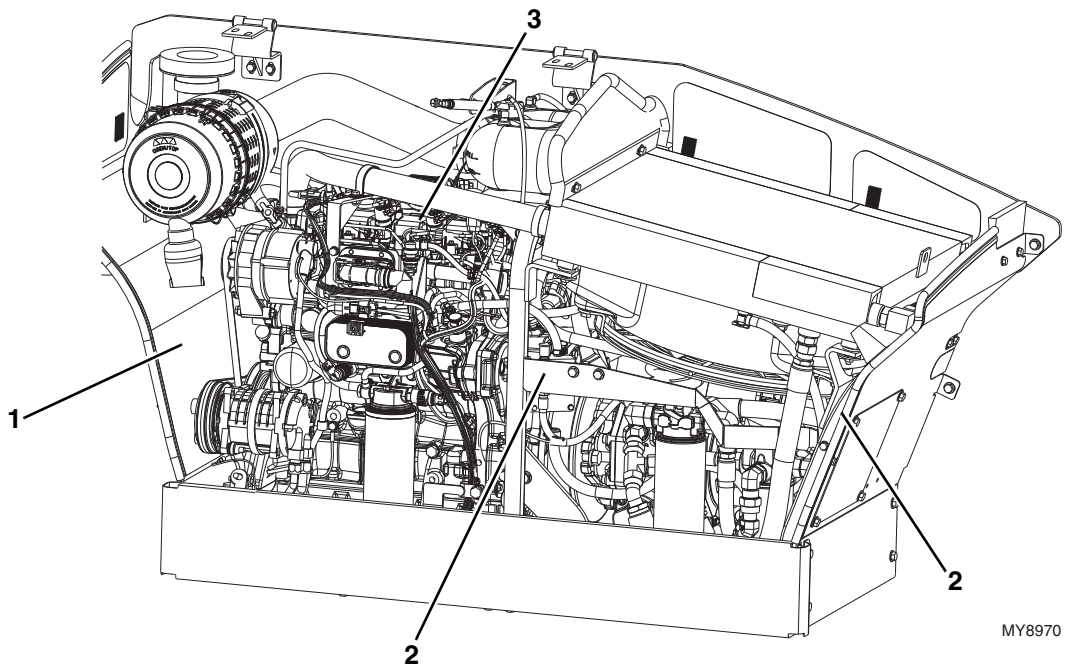


5. Loosen the clamp (**3**) securing the air intake elbow to the air cleaner assembly. Pull the air intake elbow off the air cleaner.
6. Remove the hardware securing the air cleaner to the air cleaner mounting plate (**4**). Remove the air cleaner assembly (**5**).

7.6.2 Air Cleaner Assembly Installation

1. Install the air cleaner assembly (**5**) to the air cleaner mounting plate with the previously used hardware (**4**). Hand torque mounting bolts to 10-12 lb-ft (13,5-16,3 Nm).
2. Place the loosened clamp (**3**) over the air intake elbow and install elbow on the air cleaner assembly.
3. Adjust and tighten clamps before starting the machine.
4. Properly connect the battery.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

7.7 ENGINE REPLACEMENT



7.7.1 Engine Removal

1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Thoroughly clean the engine and surrounding area, including all hoses and fittings before proceeding.
5. Properly disconnect the battery.
6. Remove the radiator/oil cooler assembly. Refer to Section 7.2.2, “Radiator/Oil Cooler Replacement.” for detailed removal instructions.
7. Drain hydraulic reservoir. Refer to Section 8.8.2, “Hydraulic Oil Reservoir Draining.”
8. Remove the air cleaner assembly. Refer to Section 7.6.1, “Air Cleaner Assembly Removal,” for detailed removal instructions.
9. Remove the exhaust system. Refer to Section 7.5.1, “Exhaust System Removal,” for detailed removal instructions.
10. Loosen and remove the rear fender (**1**).
11. Label, disconnect and cap all hydraulic hoses attached to engine and transmission, cap all fittings and plug hoses to keep dirt & debris from entering hydraulic system.
12. Label, disconnect and cap all fuel lines. Install a plug in the end of each line.
13. Remove hydraulic and fuel filters, and radiator/oil cooler assembly bracket assembly (**2**).
14. Label and disconnect all wire connections on the engine and transmission.
15. Secure the engine (**3**) with a lifting strap or chain from the appropriate lifting points. Use a suitable hoist or overhead crane.
16. Remove the four motor mount bolts that attach the engine to the frame.
17. Carefully lift the engine from the machine. Avoid causing damage to the surrounding parts.
18. Lift the engine clear of the machine, and lower it onto suitable supports or stand. Secure the engine so that it will not move or fall.

7.7.2 Engine Disassembly, Inspection and Service

Engine disassembly, internal inspection, service, repair and assembly procedures are covered in the Deutz Engine manual. Several special engine service tools are required to properly service the Deutz engine. Contact the local **JLG** dealer for further information.

Note: *If the engine is being replaced, there may be external components that will be required to be transferred from the original engine to the replacement engine depending upon who you purchase the new engine from and the configuration of your replacement engine. Refer to the appropriate **JLG** user manual for detailed procedures that cover the transfer of original engine components to the replacement engine.*

7.7.3 Engine Installation

Note: *Refer to Section 2.3, "Torque Charts," for specific fastener torque specifications.*

1. Position engine (**3**) in engine compartment being sure to line up the four motor mount holes. Replace bolts and torque to 185 lb-ft (251 Nm).
2. Reattach any previously labeled wire connections on the engine and transmission.
3. Install the hydraulic and fuel filters, and radiator/oil cooler assembly bracket assembly (**2**).
4. Install the previously removed rear fender (**1**).
5. Remove the plugs and connect all previously labeled fuel lines.
6. Install the exhaust assembly. Refer to Section 7.5.2, "Exhaust System Installation." for detailed installation instructions.
7. Install the air cleaner assembly. Refer to Section 7.6.2, "Air Cleaner Assembly Installation." for detailed installation instructions.
8. Install the radiator/oil cooler assembly. Refer to Section 7.2.2, "Radiator/Oil Cooler Replacement." for detailed installation instructions.
9. Uncap and reconnect all hydraulic hoses and fittings to the engine and transmission. Keep hoses free of dirt & debris.
10. Refill the hydraulic reservoir (Refer to the appropriate Operation & Safety Manual for information concerning the hydraulic oil and filter change).
11. Properly connect the battery.
12. Check that all hydraulic, electrical, cooling, fuel and exhaust system connections are correct and connected tightly.
13. Run engine to normal operating temperature then shut off the engine. While the engine is cooling, check for leaks.
14. Allow the engine to cool. Check the radiator coolant level, and top off with a 50/50 mixture of ethylene glycol and water. Replace the radiator cap.

NOTICE

During the full throttle check:

- ***DO NOT*** *operate any hydraulic function.*
- ***DO NOT*** *steer or apply any pressure to the steering wheel.*
- *Keep the transmission in NEUTRAL (N).*

15. Check for leaks from the engine, main hydraulic pump and lines, transmission, hydraulic reservoir and fuel tank. Check the levels of all fluids and lubricants. Fill as required.
16. Purge the hydraulic system of air by operating all boom functions through their entire range of motion several times. Check the hydraulic oil level.
17. Check for proper operation of all components.
18. Turn the engine OFF.
19. Install the belly pan.
20. Install the engine cover. Close and secure the cover.
21. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

Section 8
Hydraulic System

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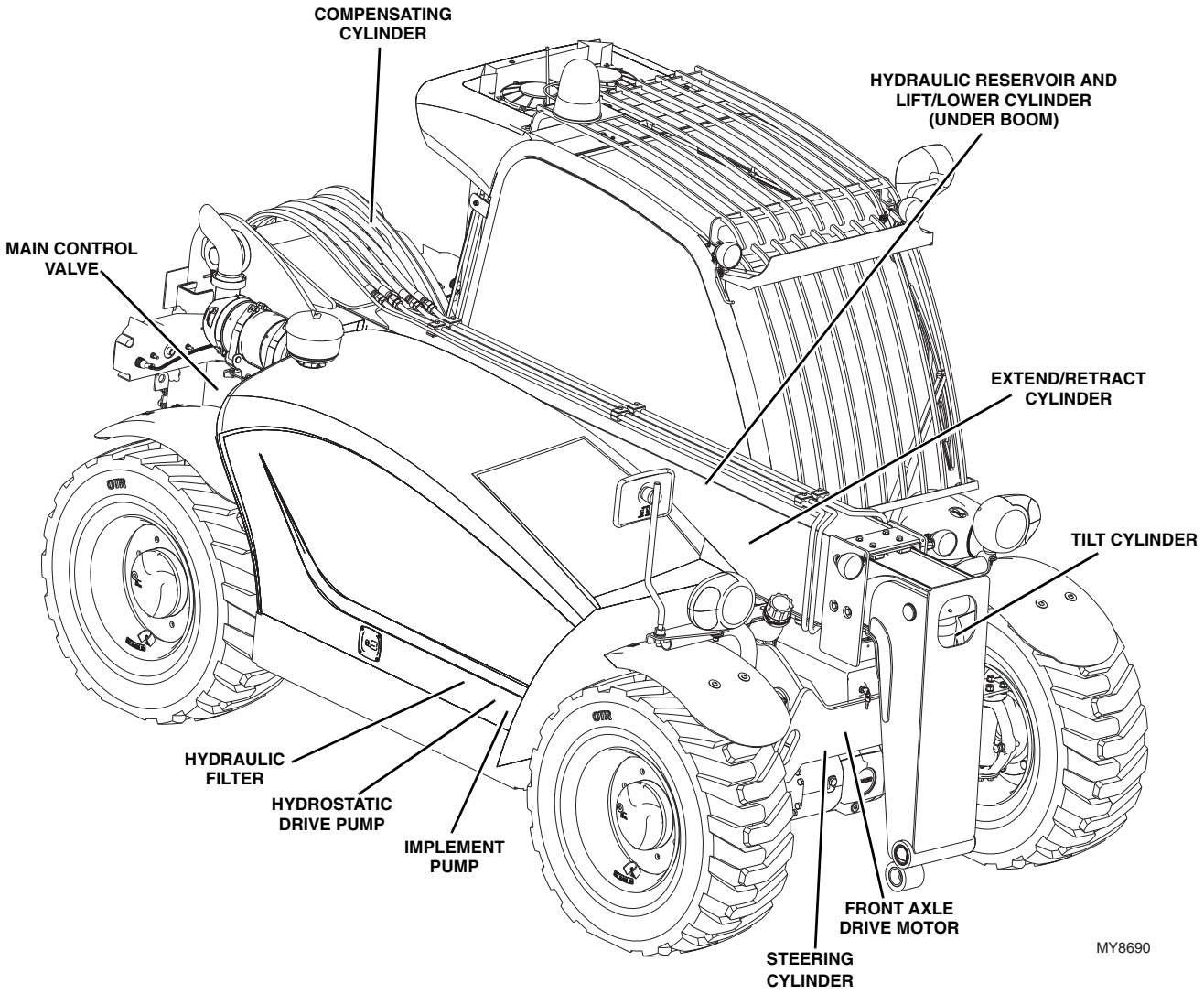
8.1 HYDRAULIC COMPONENT TERMINOLOGY

To understand the safety, operation and service information presented in this section, it is necessary that the operator/mechanic be familiar with the name and location of the hydraulic components of the machine. The following illustration identifies the components that are referred to throughout this section.



8.2 SAFETY INFORMATION

WARNING

DO NOT service the machine without following all safety precautions as outlined in the “Safety Practices” section of this manual.

8.3 GENERAL INFORMATION

Petroleum-based hydraulic fluids are used in this machine. The temperature of hydraulic fluid increases during the operation of various hydraulic functions. A heated petroleum-based hydraulic fluid presents a fire hazard, especially when an ignition source is present.

Accordingly, periodically inspect all hydraulic system components, hoses, tubes, lines, fittings, etc. Carefully examine any deterioration and determine whether any further use of the component would constitute a hazard. If in doubt, replace the component.

Whenever you disconnect a hydraulic line, coupler, fitting or other component, slowly and cautiously loosen the part involved. A hissing sound or slow seepage of hydraulic fluid may occur in most cases. After the hissing sound has ceased, continue removing the part. Any escaping oil should be directed into an appropriate container. Cap or otherwise block off the part to prevent further fluid seepage.

Hydraulic system maintenance will, at times, require that the engine be operated. Always follow safety precautions.

A major cause of hydraulic component failure is contamination. Keeping the hydraulic fluid as clean as possible will help avoid downtime and repairs. Sand, grit and other contaminants can damage the finely machined surfaces within hydraulic components. If operating in an exceptionally dirty environment, change filters and inspect the fluid more often. When servicing the system, cap or plug hydraulic fittings, hoses and tube assemblies. Plug all cylinder ports, valves and the hydraulic reservoir, and pump openings until installation occurs. Protect threads from contamination and damage.

Some hydraulic functions are actuated by interfacing with electrical system components (switches, solenoids and sensors). When the hydraulic system is not functioning properly, check the electrical aspect of the malfunctioning circuit also.

8.4 SPECIFICATIONS

Refer to Section 4, “After connection has been properly tightened, mark a straight line across the connecting parts, not covering dots indicating that connection has been properly tightened.,” for hydraulic system specifications.

8.5 HOSES, TUBE LINES, FITTINGS, ETC.

There are numerous hydraulic hoses, tubes, fittings, etc. used on this machine. Periodically inspect all of these and carefully examine any signs of wear, abrasion and/or deterioration. Determine whether any further use of the component would constitute a hazard. If in doubt, replace the component.

8.5.1 Replacement Considerations

Conditions including, but not limited to, the following are sufficient for considering component replacement:

1. Any evidence of hydraulic fluid leakage at the surface of a flexible hose or its junction with the metal and couplings.
2. Any blistering or abnormal deformation to the outer covering of a hydraulic hose.
3. Hydraulic oil leakage at any threaded or clamped joint that cannot be eliminated by normal tightening or other recommended procedures.
4. Evidence of excessive abrasion or scrubbing on the outer surface of a hose, rigid tube, or hydraulic fitting. Modification must be made to eliminate the interference of the elements in contact with one another, or to otherwise protect the components from contact with one another. Slightly moving a hose or adjusting a plastic tie wrap may often be all that is necessary to eliminate interference; evaluate each situation and proceed as required by the individual circumstances.

8.5.2 Hose, Tube, Line and Fitting Replacement

Before removing a hydraulic hose or component, always mark or otherwise label the related parts and the exact location of the hose or component to aid in proper reinstallation. Hydraulic fluid is a good cleaner and can remove most liquid-ink type markings, so make sure the mark or label will remain intact. Alternative methods to using markers include color-coded tie wraps, number-tag sets, alpha-numeric stampings or markings, and suitably labeled pieces of tape. Select an appropriate marking method for the conditions and proceed accordingly.

NEVER replace a hydraulic hose or other component with a part not specifically designed for this machine. Use only factory approved parts for best performance and safety.

Removal and replacement of hoses, tube lines, fittings, etc. usually involves straightforward procedures. When removing a hydraulic hose or other component, be aware that o-rings are used throughout the hydraulic system. ALWAYS replace a used o-ring with a new part.

Check all routing of hoses, wiring and tubing for sharp bends or interference with any rotating members. Install appropriate protective devices such as tie wraps and conduit to help shield hoses from damage. All tube and hose clamps must be tight.

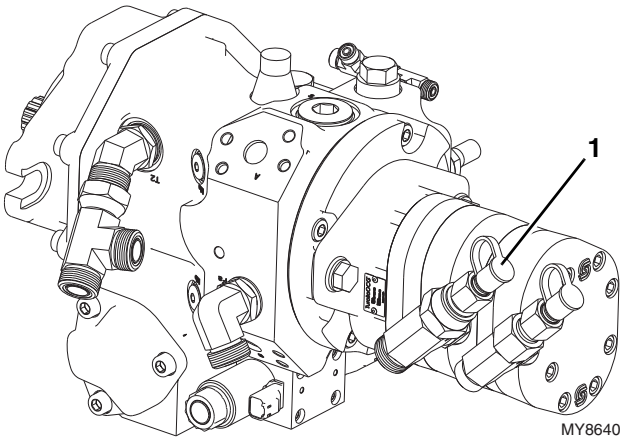
8.6 HYDRAULIC PRESSURE DIAGNOSIS

8.6.1 Pressure Checks and Adjustments

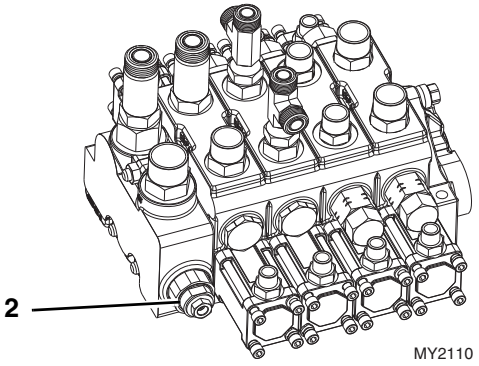
In general, follow the steps below whenever conducting pressure checks and performing adjustments:

1. Park the machine on a firm, level surface. Engage the park brake, place the transmission control lever in (N) NEUTRAL, place the neutral lock lever in the (N) NEUTRAL LOCK position, level the boom and turn the engine OFF.
2. Pressure tee fittings are conveniently located in each hydraulic circuit. Install a pressure gauge capable of measuring at least 10% more pressure than that which the circuit being checked operates under.
3. Start the engine. Operate machine functions several times to allow hydraulic oil to reach operating temperature. The hydraulic oil temperature should be between 100-120° F (38-49° C). If a temperature gauge or thermometer is unavailable, the hydraulic oil reservoir should be warm to the touch.
4. Fully depress the accelerator pedal as required. Place and hold the joystick in the position needed to operate the particular machine function being checked. Continue holding the joystick in position until pressure readings are taken.
5. Check the pressure gauge reading. It should read as described in the appropriate section. If the reading is not as specified, turn the engine OFF and check other components in the system. Verify that all related hydraulic components and electrical switches, sensors, solenoids, etc. are operating correctly.
6. As a last resort, adjust the appropriate relief valve, if applicable. Turning the adjustment screw clockwise will increase the pressure; turning the screw counterclockwise will decrease the pressure.

8.6.2 Main Control Valve Pressure Checking

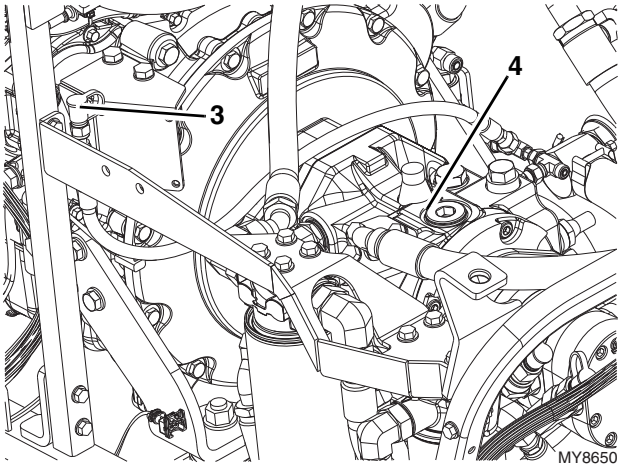


1. Attach 5000 psi (345 bar) gauge to the test port (**1**) at the rear of the implement pump to check the system pressure. Make sure the gauge is visible from inside the cab.
2. See Section 8.6, “Hydraulic Pressure Diagnosis,” for start up procedure. Check the main control pressure with the park brake on and the service brake off at full throttle. Retract a boom circuit function until the cylinder bottoms. The main control valve pressure should be 3585-3665 psi (247-252,7 bar) at full throttle. Repeat for each boom circuit to verify the correct main control valve pressure.



3. If a pressure adjustment is required, adjust the main relief cartridge (**2**) on the main control valve. Recheck pressure after any adjustment has been made.

8.6.3 Charge Pressure Checking



1. Attach a pressure gauge to the test port (**3**) on the hydrostatic transmission (**4**) to check the system pressure. The pressure should be 350-410 psi (24,1- 28,2 bar) with the engine at low idle.
2. The charge pressure relief valve is preset at the factory and is not adjustable.

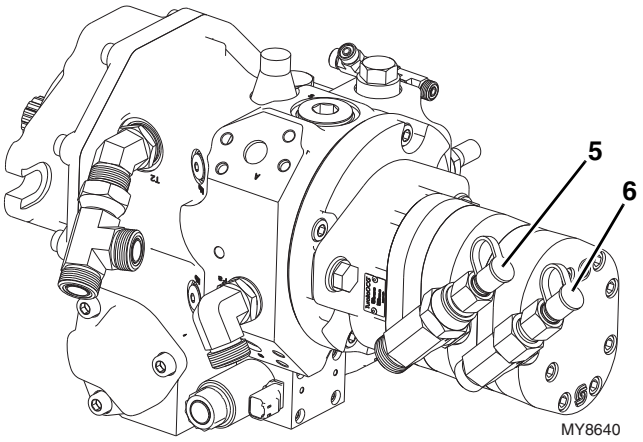
8.6.4 Boom Function Pressure Checking

1. Attach 5000 psi (345 bar) gauge to the test port (**5**) at the rear of the implement pump to check the system pressure. Make sure the gauge is visible from inside the cab.
2. See Section 8.6, “Hydraulic Pressure Diagnosis,” for start up procedure. Check the boom function pressure with the park brake on and the service brake off at full throttle. Retract each boom circuit function until the cylinder bottoms. Each circuit function pressure should be 3585-3665 psi (247-252,7 bar) at full throttle.

Note: *With the machine at operating temperature, the* 3585-3665 psi (247-252,7 bar) *pressure reading at the main control valve is 125 psi (13,3 bar) HIGHER than the 3450-3550 psi (237,8-244,7 bar) of each individual valve section function. DO NOT adjust the main control valve relief pressure below* 3585-3665 psi (247-252,7 bar)*. To check individual valve section pressures, install a tee and test port between the cylinder being checked and the corresponding valve section on the main control valve.*

The individual valve section relief valves are preset at the factory and are not adjustable.

8.6.5 Steering Pressure Checking



1. Attach a pressure gauge to the test fitting (**5**) at the rear of the implement pump. The pressure reading should be 2490-2590 psi (171,7-178,6 bar) with the steering wheel fully turned to the steering stop in one direction.
2. There is no adjustment for steering pressure.

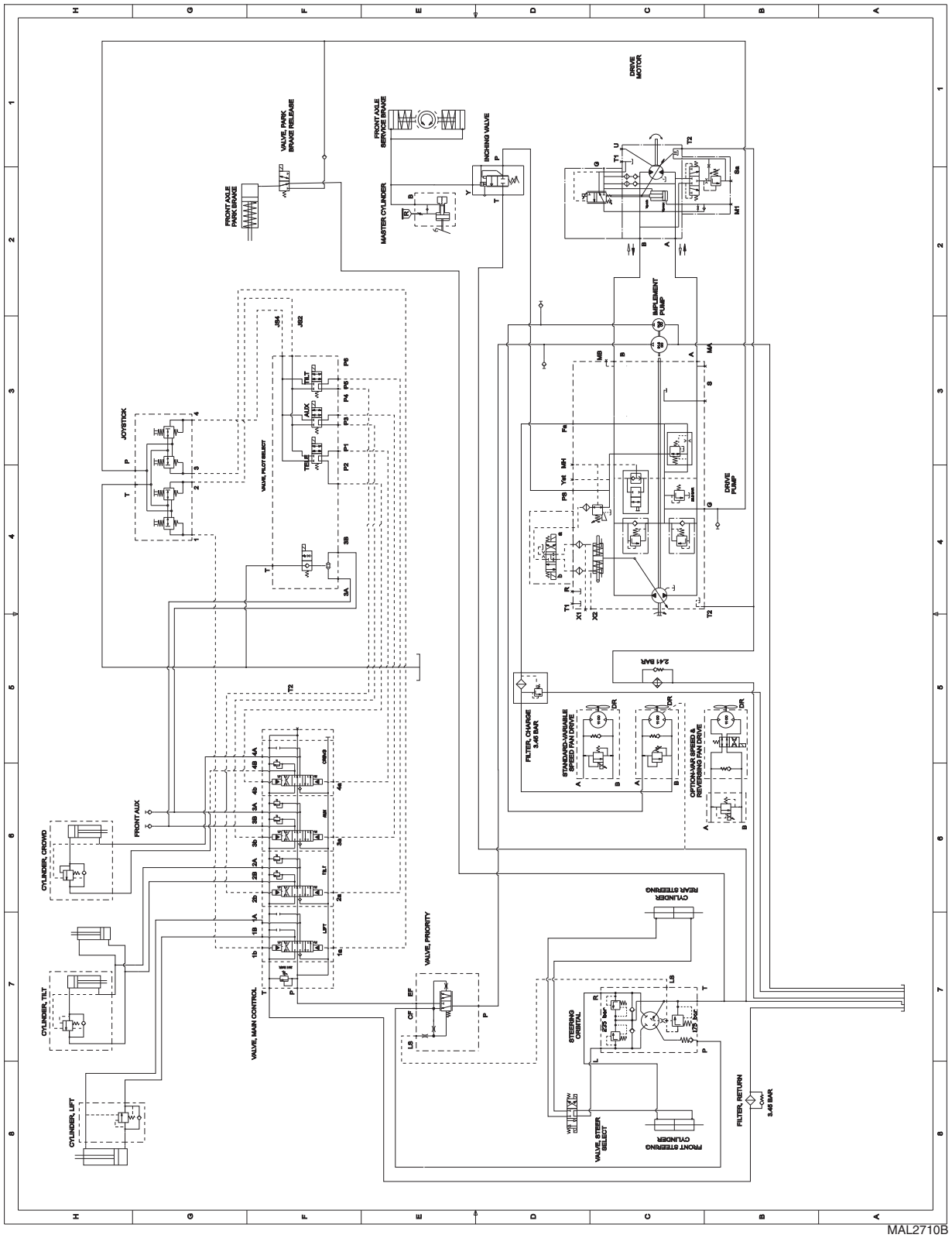
8.6.6 Fan Speed Pressure and Direction Checking

1. Place a piece of paper over the face of the radiator core. If the paper is held in place, the fan is rotating in the right direction.
2. Attach a pressure gauge to the test fitting (**6**) at the rear of the implement pump.
3. If the machine is equipped with either the variable fan option or the variable, reversing fan option; run the engine at high idle and measure the fan speed using a suitable portable stroboscope adjustable to fractional RPM, and with the ability to distinguish actual RPM from harmonic frequencies. The fan speed must be a minimum of 2800 RPM at high idle.
4. Connect the **JLG** Analyzer and activate the Test Mode to drive the fan to the maximum fan RPM.

Note: *Refer to*

5. The pressure reading should be 2400 psi (166 bar) at high idle.

8.7 HYDRAULIC SCHEMATIC



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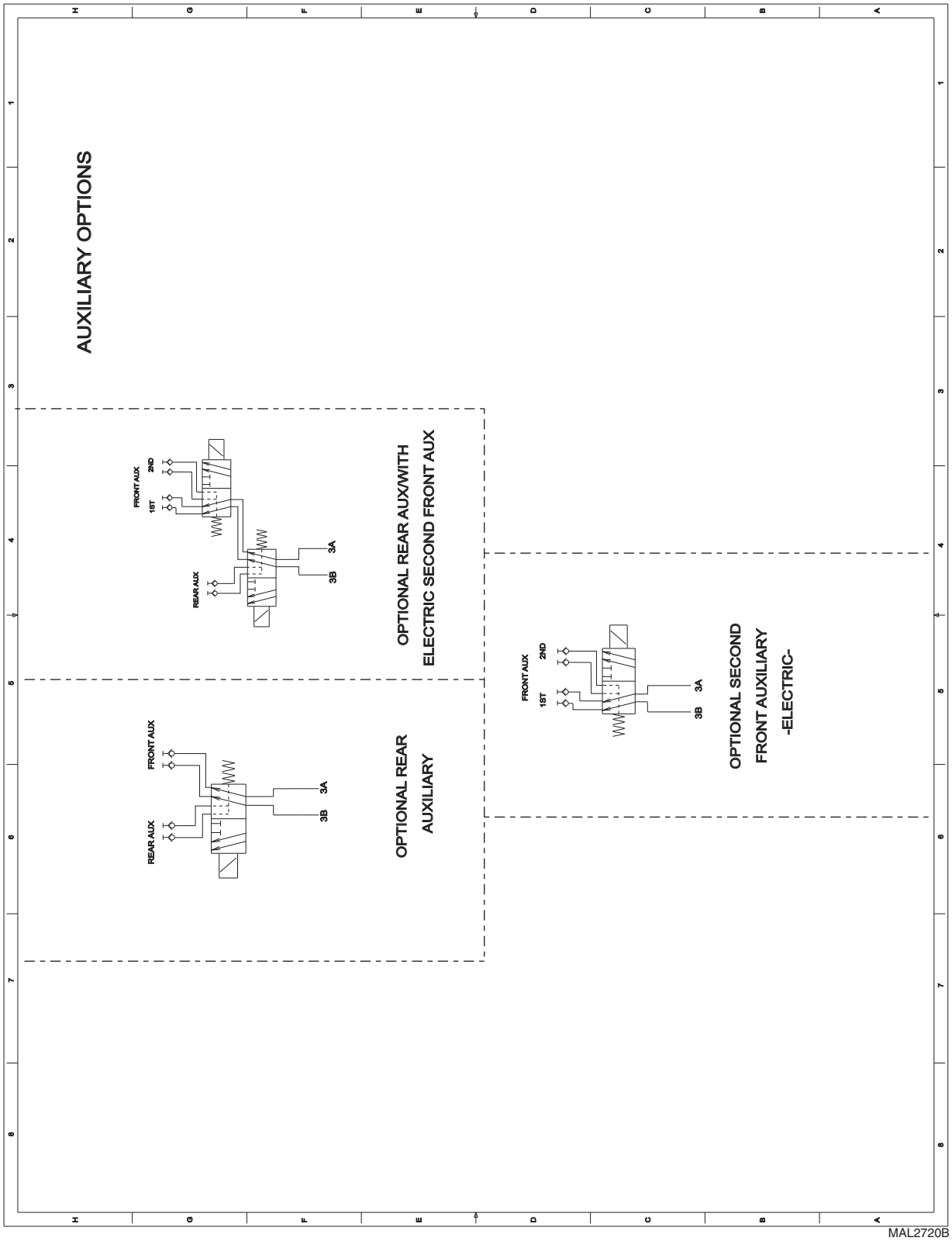

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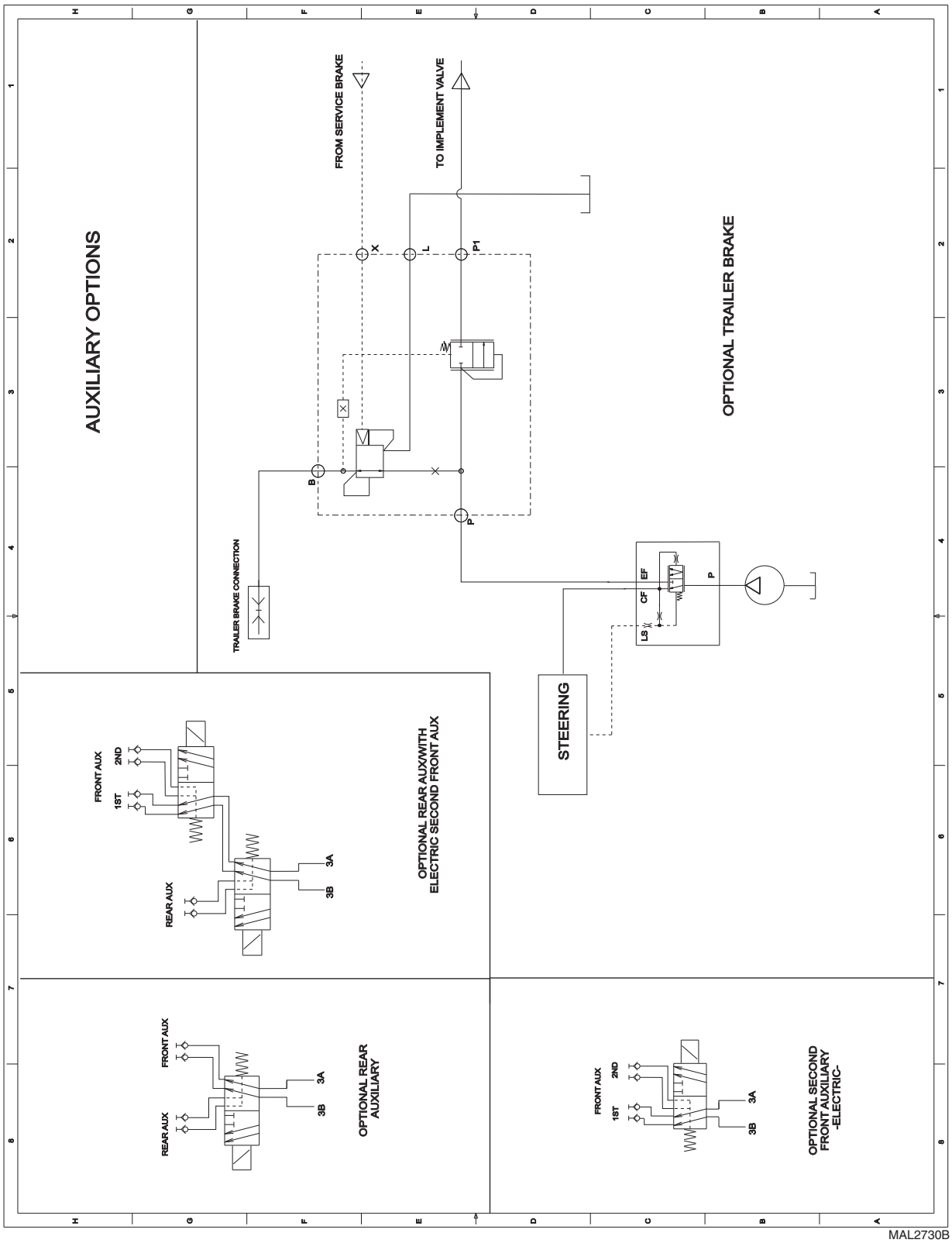

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8.8 HYDRAULIC RESERVOIR

The hydraulic reservoir and fuel tank are part of the frame. For this reason, neither tank can be removed. For cleaning instructions, see Section 7.4.2, “Fuel/Hydraulic Oil Tank.”

Occasionally, fluid may seep, leak or be more forcefully expelled from the filter head when system pressure exceeds the rating of the filter head or filler cap. If the return filter becomes plugged, return hydraulic oil will bypass the filter when pressure reaches 22 psi (1,5 bar) and return to the reservoir unfiltered.

Carefully examine fluid seepage or leaks from the hydraulic reservoir to determine the exact cause. Clean the reservoir and note where any seepage occurs.

Leaks from a cracked or damaged reservoir require that the reservoir be flushed completely with water and repaired by a certified welder using approved techniques. If these conditions cannot be met, the reservoir must be replaced in its entirety. Contact the local **JLG** dealer should reservoir welding be required.

8.8.1 Pressurized Hydraulic Oil Fill Cap

The fill cap will allow the hydraulic oil reservoir to pressurize to 2 psi (0,14 bar). Inspect the condition of the cap seal to maintain proper reservoir pressure.

8.8.2 Hydraulic Oil Reservoir Draining

1. Park the machine on a firm, level surface, fully retract the boom, support the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Remove the drain plug at the bottom of the hydraulic oil reservoir.
6. Transfer the used hydraulic oil into a suitable, covered container, and label as "Used Oil”. Dispose of used oil at an approved recycling facility. Clean and reinstall the drain plug.
7. Wipe up any spilled hydraulic oil.

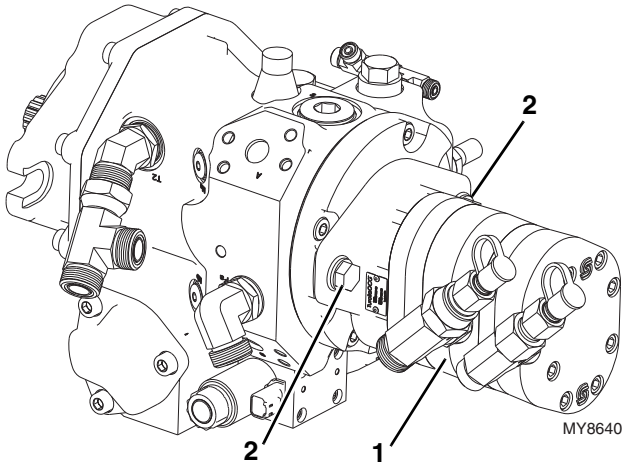
8.8.3 Hydraulic Oil Reservoir Filling

1. Be sure the reservoir is clean and free of all debris.
2. Install new hydraulic oil filters.
3. Fill the reservoir with Cat HDO oil. Refer to Section 2.5, “Fluids, Lubricants and Capacities.”
4. Properly connect the battery.
5. Close and secure the battery and engine covers.
6. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.
7. Start the machine. Run engine to normal operating temperature. Operate all hydraulic functions.

8.9 HYDRAULIC SYSTEM PUMP

8.9.1 Implement Pump Removal

1. Park the machine on a firm, level surface, fully retract the boom, support the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Loosen and remove the belly pan and front fender.
6. Drain the hydraulic oil reservoir. Refer to Section 8.8.2, “Hydraulic Oil Reservoir Draining.”



7. Thoroughly clean the pump (**1**) and surrounding area, including all hoses and fittings before proceeding.
8. From under the machine, label, disconnect and cap all hydraulic hoses attached to the pump, cap all fittings and plug hoses to keep dirt & debris from entering the hydraulic system.
9. Remove the two bolts and washers (**2**) securing the pump in place.

8.9.2 Implement Pump Installation

1. Position pump in the mounting position.

Note: *Use new o-rings where required. Never reuse o-rings.*

2. Use the two previously removed bolts and washers to secure the pump into place. Torque to 64 lb-ft (87 Nm).
3. Uncap and reconnect previously labeled hydraulic hoses to their proper locations.
4. Fill the hydraulic reservoir with clean, filtered hydraulic oil.
5. Prime the pump by filling the case drain port with fresh, filtered hydraulic oil from a clean container before installing the case drain connector and hose.
6. Check all routing of hoses and tubing for sharp bends or interference with any rotating members. All tube and hose clamps must be tight.
7. Properly connect the battery.
8. Start the engine and run at approximately one-third to one-half throttle for about one minute without moving the machine or operating any hydraulic functions.
9. Inspect for leaks and check all fluid levels.
10. Install the front fender and belly pan.
11. Close and secure the battery and engine covers.
12. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

Note: *Check for leaks and repair as required before continuing.*

13. Close and secure the engine covers.
14. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

8.9.3 Pump Test

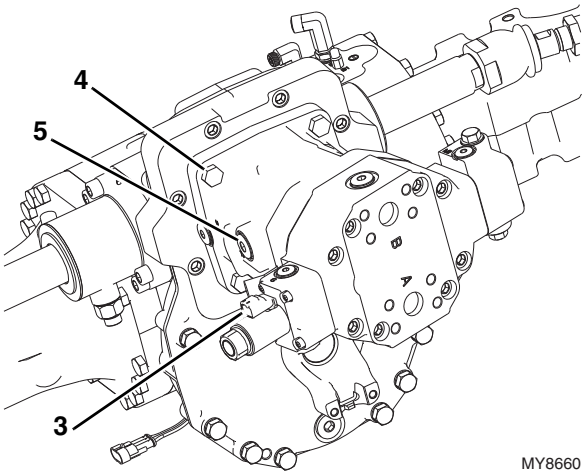
1. Perform a flow meter test on the pump.
2. Check the system functions.

8.10 FRONT DRIVE MOTOR

For internal service instructions and detailed specifications, contact the local **JLG** Dealer.

8.10.1 Front Drive Motor Removal

1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Drain the hydraulic reservoir or attach a vacuum adapter fitting to the reservoir fill tube to reduce oil spillage.
6. Label and disconnect all hydraulic hoses attached to the pump, cap all fittings and plug hoses to keep dirt & debris from entering hydraulic system.
7. Disconnect the electrical connector (**3**) on the proportional valve.



8. Support the motor and remove the four bolts (**4**) securing the motor to the front axle.

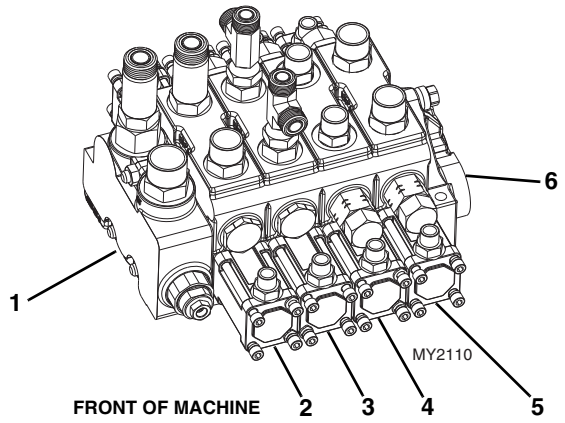
8.10.2 Front Drive Motor Installation

1. Install the motor onto the front axle and secure with the four previously removed bolts (**4**). Torque to 72 lb-ft (97 Nm). Use only new seals.
2. Uncap and reconnect the previously labeled hydraulic hoses to their appropriate locations.
3. Fill the motor with hydraulic fluid through the fill plug (**5**) before starting the machine.
4. Refill the hydraulic reservoir and inspect for leaks around the machine.
5. Properly connect the battery.
6. Start the engine and run at approximately one-third to one-half throttle for about one minute without moving the machine or operating any hydraulic functions.
7. Inspect for leaks and check all fluid levels.
8. Close and secure the battery and engine covers.
9. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

8.11 CONTROL VALVES

8.11.1 Main Control Valve

The main control valve is mounted on the rear of the machine behind the rear access panel.



The main control valve assembly consists of various working sections with their own valve assemblies, each providing a specific hydraulic function. The section assemblies are the left-hand end cover (**1**), lift/lower (**2**), tilt (**3**), auxiliary (**4**), crowd (**5**) and right-hand end cover (**6**) sections.

a. Main Control Valve Removal

1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Remove the rear panel. Allow the hydraulic fluid to cool.
6. Thoroughly clean the main control valve and surrounding area, including all hoses and fittings, before proceeding.
7. Place a suitable container to catch hydraulic fluid drainage beneath the frame.
8. Label, disconnect and cap all the hydraulic hoses attached to the main control valve. Cap all fittings and openings to keep dirt & debris from entering the hydraulic system.
9. Wipe up any hydraulic fluid spillage in, on, near and around the machine and the work area.
10. Remove the four bolts securing the main control valve to the frame bracket.

b. Main Control Valve Disassembly

1. To disassemble the individual sections of the main control valve, remove the nuts from the end of the tie rods. Pull the tie rods out through the sections.
2. Disassemble each section assembly as required.

Some sections include a pre-adjusted relief valve that regulates pressure in a specific circuit.

NOTICE

DO NOT adjust any of the relief valve assemblies! Tampering with a relief valve will irrevocably alter pressure in the affected circuit, requiring re-calibration or a new relief valve.

Disassemble each Valve Section

1. Carefully separate the end cover section from the lift/lower section.
2. Remove the o-rings from between the two sections.
3. Carefully separate each remaining section and remove all o-rings and seals.
4. Remove any plugs, check valves, compensator valves, anti-cavitation valves, shock valves or the rectangular hydraulic remote positioners from each individual valve section if equipped.
5. Keep all parts being removed from individual valve sections tagged and kept together.

c. Main Control Valve Parts Cleaning

Clean all components with a suitable cleaner, such as trichlorethylene, before continuing. Blow dry.

d. Main Control Valve Parts Inspection

Inspect all parts and internal passageways for wear, damage, etc. If inner surfaces of any component **DO NOT** display an ultra-smooth, polished finish, or are damaged in any way, replace the damaged part. Often, dirty hydraulic fluid causes failure of internal seals, damage to the polished surfaces within the component, and wear of and/or harm to other parts.

e. Main Control Valve Assembly

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

Assemble each Valve Section

1. Reassemble any plugs, check valves, compensator valves, anti-cavitation valves, shock valves or hydraulic remote positioners from individual valve sections if equipped.
2. Install the end covers onto Lift/Lower and Crowd sections.

Assemble the Main Control Valve

1. Place all three tie rods with the washers and nuts through the end main control valve section.
2. Stand the end main control valve section on end.
3. Install proper o-rings on the inner face of the end main control valve section. Align the Crowd section over the three tie rods and slide onto the end main control valve section.
4. Using proper o-rings and load sense shuttle, repeat step three for the remaining sections.
5. Install the washers and nuts on the tie rods and torque to 18.5 lb-ft (25 Nm).

f. Main Control Valve Installation

1. Loosely install the four main control valve mounting bolts through bracket on the rear of the machine.
2. Install the main control valve onto the bracket, aligning the bolts with the holes in the end sections of the main control valve. Slide the main control valve into position, and tighten the bolts.
3. Prime the main control valve by filling the inlet openings with fresh, filtered hydraulic oil from a clean container, before attaching the hoses.
4. Use new oiled o-rings as required. Uncap and reattach and secure all hoses, clamps, etc. to the main control valve.
5. Check the routing of all hoses, wiring and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all tube and hose clamps.
6. Properly connect the battery.
7. Start the engine and run at approximately one-third to one-half throttle for about one minute without moving the machine or operating any hydraulic functions.
8. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.
9. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
10. Install the rear panel.
11. Close and secure the battery and engine covers.
12. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

g. Main Control Valve Test

Conduct a pressure check of the hydraulic system in its entirety. Adjust pressure(s) as required. Refer to Section 8.6.2, “Main Control Valve Pressure Checking.”

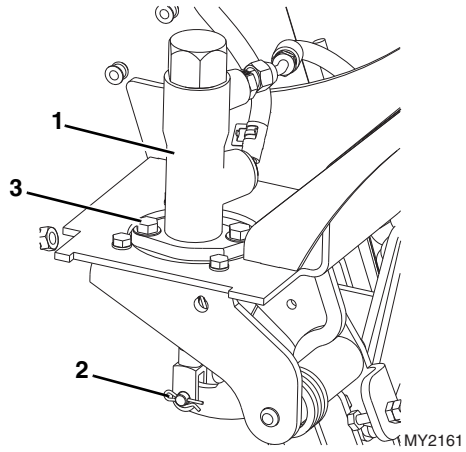
8.11.2 Service Brake Valve

The service brake valve is at the base of the steering column support, concealed by the lower dash cover.

The service brakes themselves are part of the front axle. Refer to Section 5.8, “Brakes,” for further information.

a. Service Brake Valve Removal

1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Remove the necessary dash panels.



6. Label, disconnect and cap the hydraulic hoses connected to the service brake valve (**1**). Cap all fittings and openings to keep dirt & debris from entering the brake system.
7. Remove the pin and clip (**2**) securing the service brake rod to the brake pedal assembly.
8. Remove the two bolts and washers (**3**) securing the service brake valve to the steering column support.

Note: ***DO NOT*** *disassemble the service brake valve. The service brake valve is not serviceable and must be replaced in its entirety, if defective.*

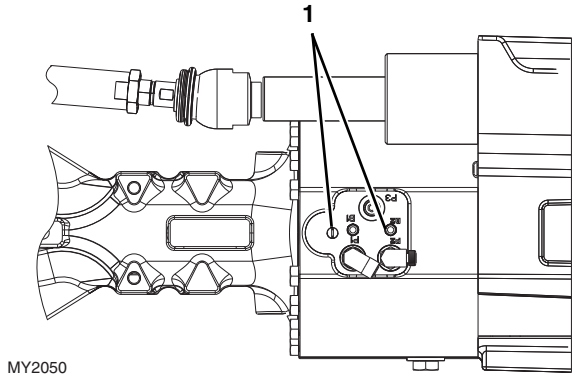
b. Service Brake Valve Installation

1. Install the service brake valve to the steering column support with the previously removed hardware (**3**). Torque as required.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

2. Use new oiled o-rings as required. Uncap and reconnect the previously labeled hydraulic hoses to the appropriate locations.
3. Install the pin and clip (**2**) securing the service brake rod to the brake pedal assembly.
4. Check the routing of all hoses, and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all tube and hose clamps.
5. Fill the brake reservoir with Mobil 424 10W-30 hydraulic oil.
6. Properly connect the battery.
7. Start the engine and run at approximately one-third to one-half throttle for about one minute, without moving the machine or operating any hydraulic functions.
8. Inspect the service brake valve and connections for leaks, and check the brake oil level. Shut the engine OFF.
9. Replace the necessary dash panels.
10. Wipe up any hydraulic oil spillage in, on, near and around the machine, work area and tools.
11. Close and secure the battery and engine covers.
12. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

c. Service Brake Bleeding Procedure



Carefully bleed the brake lines as soon as the brake valve is installed on the machine. Air in the system will not allow the brakes to apply properly. There are two brake bleeder locations (**1**) on the front axle. The outside bleeder is used for the park brake circuit. The inside bleeder is used for the service brake circuit. Work with an assistant to perform this procedure.

1. Place the transmission control lever in (N) NEUTRAL, engage the park brake, and start the engine.Raise the boom to access the brake bleeders. Support boom and turn off engine.
2. Remove the plastic cap from the brake bleeder. Attach one end of a length of transparent tubing over the brake bleeder. Place the other end of this tubing in a suitable transparent container that is partially filled with hydraulic oil. The end of the tubing must be below the oil level in the container.

3. **DO NOT** open the brake bleeder without holding the tubing firmly on the bleeder. There is pressure at the brakes. Have an assistant depress the brake pedal. Carefully open the bleeder with a 12 mm wrench. Close the brake bleeder when air bubbles no longer appear in the oil. Release the brake pedal. Remove the tubing from the brake bleeder.
4. If bleeding the service brake circuit, install a vacuum pump on the brake reservoir and remove the remainder of the trapped air from the brake system.
5. The inching valve may also require bleeding, refer to Section 8.11.7, “Inching Valve.”
6. Check brake fluid level and add fluid if necessary. Refer to Section 2.5, “Fluids, Lubricants and Capacities.”

d. Brake Performance Test

1. Press down on the service brake pedal. The pedal should NOT travel to the cab floor. Start the machine, shift into forward, release the park brake and slowly accelerate. Apply the service brake carefully noting the performance of the service brake system. If the service brakes do not safely stop the machine, repeat the service brake bleeding procedure.

8.11.3 Park Brake Valve (G5-18A)

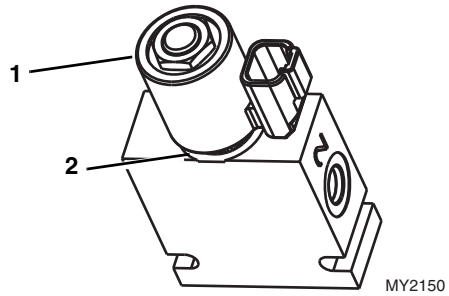
The park brake valve is located in the cab, below the seat.

a. Park Brake Valve Removal

1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Remove the four capscrews holding the cover below the seat. The park brake valve is mounted on the backside of the cover.
6. Label, disconnect and cap the hydraulic hoses on each side and bottom of the park brake valve. Disconnect and cap all hoses, fittings, etc.
7. Remove the two capscrews, and two lockwashers mounting the park brake valve to the cover.

b. Park Brake Valve Disassembly, Cleaning, Inspection and Assembly

1. Place the park brake valve on a suitable work surface.



2. Remove the solenoid valve (**1**) and cartridge (**2**) from the park brake housing.
3. Clean all components with a suitable cleaner before inspection.
4. Inspect the solenoid cartridges for proper operation. Check by shifting the spool to ensure that it is functioning properly. Check that the spring is intact. Inspect the cartridge interior for contamination.
5. Inspect internal passageways of the park brake manifold and valve for wear, damage, etc. If inner surfaces of the manifold **DO NOT** display an ultra-smooth, polished finish, or components are damaged in any way, replace the manifold or appropriate part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the unit.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

6. Install the solenoid valves and cartridges in the park brake housing.

c. Park Brake Valve Installation

1. Install the park brake valve with the two lockwashers and two capscrews to the cover.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

2. Use new oiled o-rings as required. Uncap, reattach and secure the three hoses.
3. Check the routing of all hoses for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required.

4. Properly connect the battery.
5. Start the engine and run at approximately one-third to one-half throttle for about one minute, without moving the machine or operating any hydraulic functions.
6. Inspect the park brake valve and connections for leaks, and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.
7. Install the park brake/cover with the four capscrews.
8. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
9. Close and secure the battery and engine covers.
10. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

d. Park Brake Valve Test.

1. Start the machine and engage the shift lever to the forward position. Slowly depress the throttle to mid idle. The parking brake will not allow the machine to move.
2. If further troubleshooting is required, refer to the Section 8.7, “Hydraulic Schematic,” or Section 9.4, “Electrical System Schematics.”

8.11.4 Hand Brake Valve (2505H & 25.5)

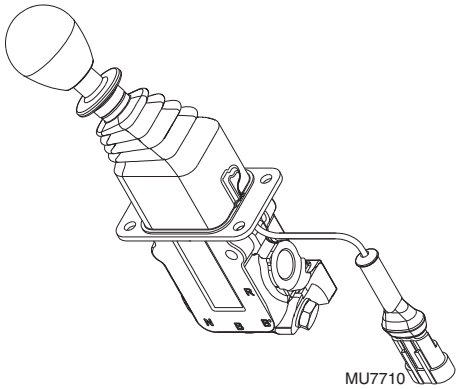
The hand brake valve is located in the cab, beside the seat.

a. Hand Brake Valve Removal

1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the hand brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Remove the two capscrews holding the cover below the seat. The hand brake valve is mounted on the mounting plate attached to the seat base.
6. Label, disconnect and cap the hydraulic hoses on each side and bottom of the hand brake valve. Disconnect and cap all hoses, fittings, etc.
7. Remove the four capscrews and lockwashers mounting the hand brake valve to the mounting plate.

b. Hand Brake Valve Disassembly, Cleaning, Inspection and Assembly

1. Place the hand brake valve on a suitable work surface.



2. Clean all components with a suitable cleaner before inspection.
3. Inspect internal passageways of the hand brake manifold and valve for wear, damage, etc. If inner surfaces of the manifold **DO NOT** display an ultra-smooth, polished finish, or components are damaged in any way, replace the manifold or appropriate part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the unit.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

c. Hand Brake Valve Installation

1. Install the Hand brake valve with the four lockwashers and capscrews to the mounting plate.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

2. Use new oiled o-rings as required. Uncap, reattach and secure the three hoses.
3. Check the routing of all hoses for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required.
4. Properly connect the battery.
5. Start the engine and run at approximately one-third to one-half throttle for about one minute, without moving the machine or operating any hydraulic functions.

6. Inspect the hand brake valve and connections for leaks, and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.
7. Install the hand brake cover with the two capscrews.
8. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
9. Close and secure the battery and engine covers.
10. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

d. Hand Brake Valve Test.

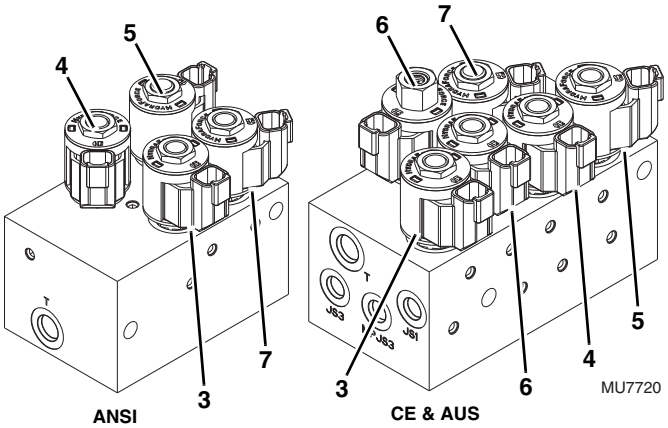
1. Start the machine and engage the shift lever to the forward position. Slowly depress the throttle to mid idle. The hand brake will not allow the machine to move.
2. If further troubleshooting is required, refer to the Section 8.7, “Hydraulic Schematic,” or Section 9.4, “Electrical System Schematics.”

8.11.5 Steering Orbitrol Valve

Refer to Section 4.4.2, “Steering Column/Valve Replacement,” for details.

8.11.6 Pilot Select Valve

The pilot select valve is attached to a manifold mounted on a mounting plate inside the frame in front of the comp cylinder.



Verify the correct operation of the pilot select valve solenoids: boom lift/lower (**3**), auxiliary (**4**), tilt (**5**), boom extend/retract (**6**) and front auxiliary (**7**) before considering replacement of the valve. The housing of the pilot select valve is not serviceable and must be replaced if defective.

a. Pilot Select Valve Removal

1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Label or otherwise mark the hydraulic hoses in relation to the pilot select valve. Disconnect and cap all hoses, fittings, solenoid wire terminal leads, etc.
6. Remove the capscrews that attach the valve to the frame.
7. Remove the pilot select valve from the machine. Wipe up any hydraulic fluid spillage in, on, near and around the machine.

b. Pilot Select Valve Disassembly, Cleaning, Inspection and Assembly

1. Place the pilot select assembly on a suitable work surface.
2. Remove the solenoid valves and cartridges (**3, 4** &**5**) from the steer select housing.
3. Clean all components with a suitable cleaner before inspection.
4. Inspect the solenoid cartridges for proper operation. Check by shifting the spool to ensure that it is functioning properly. Check that the spring is intact. Inspect the cartridge interior for contamination.
5. Inspect internal passageways of the steer select manifold and valve for wear, damage, etc. If inner surfaces of the manifold **DO NOT** display an ultra-smooth, polished finish, or components are damaged in any way, replace the manifold or appropriate part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the unit.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

6. Install the solenoid valves and cartridges in the pilot select housing.

c. Pilot Select Valve Installation

1. Attach the pilot select manifold valve to the mounting plate on the frame using the socket head capscrews.
2. Connect the hydraulic hoses, fittings, solenoid wire terminal leads, etc., to the pilot select valve.
3. Check the routing of all hoses, wiring and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all tube and hose clamps.
4. Properly connect the battery.
5. Start the engine and run at approximately 1/3-1/2 throttle for about one minute, without moving the machine or operating any hydraulic functions.
6. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.
7. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
8. Close and secure the battery and engine covers.
9. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

d. Pilot Select Valve Test

1. Check boom lift/lower, auxiliary and tilt for proper function.
2. If further troubleshooting is required, refer to Section 8.7, “Hydraulic Schematic,” or Section 9.4, “Electrical System Schematics,” for details.

8.11.7 Inching Valve

The inching valve is attached at the front of the frame directly above the steer select valve.

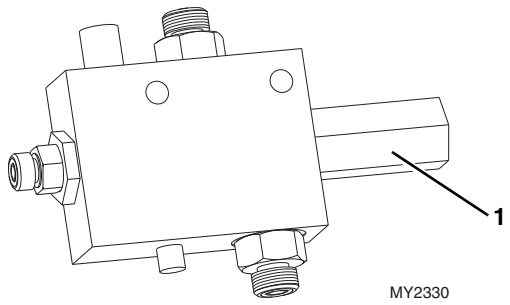
Verify the correct operation of the inching valve before considering replacement of the valve. The housing of the inching valve is not serviceable and must be replaced if defective.

a. Inching Valve Removal

1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Label or otherwise mark the hydraulic hoses in relation to the inching valve. Disconnect and cap all hoses, fittings, etc.
6. Remove the capscrews that attach the valve to the frame.
7. Remove the inching valve from the machine. Wipe up any hydraulic fluid spillage in, on, near and around the machine.

b. Inching Valve Disassembly, Cleaning, Inspection and Assembly

1. Place the inching valve assembly on a suitable work surface.



2. Remove the cartridge (**1**) from the inching valve housing.
3. Clean all components with a suitable cleaner before inspection.

4. Inspect the cartridge for proper operation. Check by shifting the spool to ensure that it is functioning properly. Check that the spring is intact. Inspect the cartridge interior for contamination.
5. Inspect internal passageways of the inching valve for wear, damage, etc. If inner surfaces of the manifold **DO NOT** display an ultra-smooth, polished finish, or components are damaged in any way, replace the manifold or appropriate part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the unit.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

6. Install the cartridge in the inching valve housing.

c. Inching Valve Installation

1. Attach the inching valve to the mounting plate on the frame using the socket head capscrews.
2. Connect the hydraulic hoses, fittings, etc., to the inching valve.
3. Check the routing of all hoses and wiring for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all hose clamps.
4. Properly connect the battery.
5. Start the engine and run at approximately 1/3-1/2 throttle for about one minute, without moving the machine or operating any hydraulic functions.
6. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

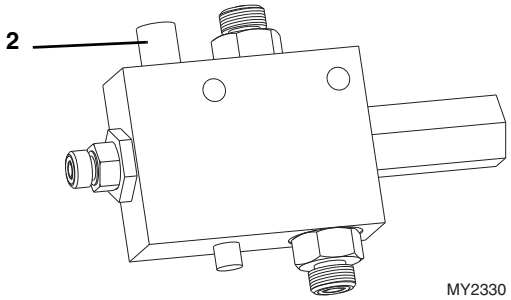
Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

7. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
8. Close and secure the battery and engine covers.
9. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

d. Inching Valve Bleeding Procedure

Carefully bleed the inching valve as soon as the inching valve is installed on the machine. Air in the system will not allow the brakes to apply properly. There is one bleeder location on the inching valve. Work with an assistant to perform this procedure.

1. Place the transmission control lever in (N) NEUTRAL, engage the park brake, start the engine and lower the boom. Turn off engine.



2. Remove the plastic cap (**2**) from the inching brake bleeder. Attach one end of a length of transparent tubing over the bleeder. Place the other end of this tubing in a suitable transparent container that is partially filled with hydraulic oil. The end of the tubing must be below the oil level in the container.
3. **DO NOT** open the bleeder without holding the tubing firmly on the bleeder. Have an assistant depress the brake pedal. Carefully open the bleeder with a 10 mm wrench. Close the bleeder when air bubbles no longer appear in the oil. Release the brake pedal. Remove the tubing from the bleeder.
4. If brake system bleeding is required, refer to Section 8.11.2, “Service Brake Valve.”
5. Check brake fluid level and add fluid if necessary. Refer to Section 2.5, “Fluids, Lubricants and Capacities.”

e. Inching Test

1. Start the machine, engage the shift lever to the forward position and release the parking brake. Slowly depress the throttle to 1/2 throttle. Slowly apply the service brake. The machine will slow, but still maintain forward movement. Continuing to depress the service brake will disengage the inching brake and engage the service brakes.
2. If further troubleshooting is required, refer to Section 8.7, “Hydraulic Schematic.”

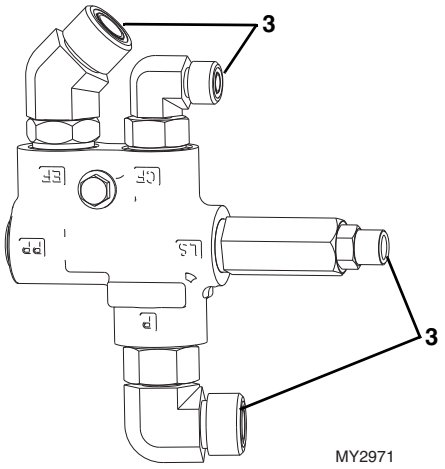
8.11.8 Priority Valve

.The priority valve is attached at the engine pod frame directly beside the engine.

Verify the correct operation of the priority valve before considering replacement of the valve. The priority valve must be replaced if defective.

a. Priority Valve Removal

1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Label or otherwise mark the hydraulic hoses in relation to the priority valve. Disconnect and cap all hoses, fittings, etc.
6. Remove the capscrews that attach the valve to the frame.
7. Remove the priority valve from the machine. Wipe up any hydraulic fluid spillage in, on, near and around the machine.

b. Priority Valve Disassembly, Cleaning, Inspection and Assembly

1. Place the priority valve assembly on a suitable work surface.
2. Label and remove the fittings (**3**) from the priority valve housing.
3. Clean all components with a suitable cleaner before inspection.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

4. Install the previously labeled fittings in the priority valve housing.

c. Priority Valve Installation

1. Attach the priority valve to the mounting plate on the frame using the socket head capscrews.
2. Connect the hydraulic hoses, fittings, etc., to the priority valve.
3. Check the routing of all hoses for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all hose clamps.
4. Properly connect the battery.
5. Start the engine and run at approximately 1/3-1/2 throttle for about one minute, without moving the machine or operating any hydraulic functions.
6. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

7. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
8. Close and secure the battery and engine covers.
9. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

d. Priority Valve Test

1. Start the machine and slowly depress the throttle to 1/2 throttle. Turn the steering and engage a boom function. The steering will continue to respond along with the engaged boom function.
2. If further troubleshooting is required, refer to Section 8.7, “Hydraulic Schematic.”

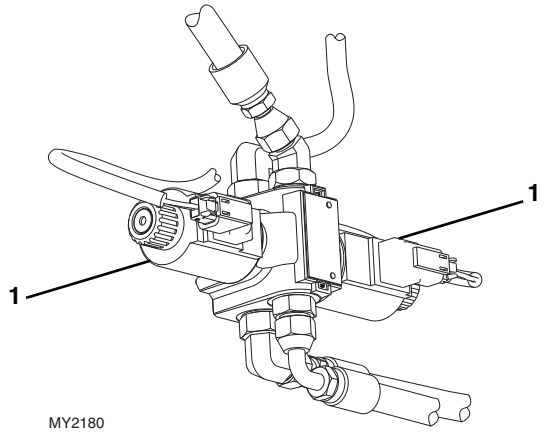
8.11.9 Steer Select Valve

The steer select valve is attached to inside the frame near the front drive motor.

Verify the correct operation of the steer select valve solenoids before considering replacement of the valve. The housing of the steer select valve is not serviceable and must be replaced if defective.

a. Steer Select Manifold and Valve Removal

1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Label or otherwise mark the hydraulic hoses in relation to the steer select manifold. Disconnect and cap all hoses, fittings, solenoid wire terminal leads, etc.
6. Remove the capscrews that attach the manifold to the frame.
7. Remove the steer select manifold with attached steer select valve from the machine. Wipe up any hydraulic fluid spillage in, on, near and around the machine.

b. Steer Select Valve and Manifold Disassembly, Cleaning, Inspection and Assembly

1. Place the steer select assembly on a suitable work surface.
2. Separate the steer select valve from the manifold by removing the capscrews. Discard the old o-rings.
3. Remove the solenoid valves and cartridges (**1**) from the steer select housing.
4. Clean all components with a suitable cleaner before inspection.
5. Inspect the solenoid cartridges for proper operation. Check by shifting the spool to ensure that it is functioning properly. Check that the spring is intact. Inspect the cartridge interior for contamination.
6. Inspect internal passageways of the steer select manifold and valve for wear, damage, etc. If inner surfaces of the manifold **DO NOT** display an ultra-smooth, polished finish, or components are damaged in any way, replace the manifold or appropriate part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the unit.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

7. Install the solenoid valves and cartridges in the steer select housing.
8. Attach the steer select valve to the manifold using new, oiled o-rings and socket head capscrews.

c. Steer Select Manifold and Valve Installation

1. Attach the steer select manifold and valve to the mounting plate on the frame using the socket head capscrews.
2. Connect the hydraulic hoses, fittings, solenoid wire terminal leads, etc., to the steer select valve and manifold.
3. Check the routing of all hoses, wiring and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all tube and hose clamps.
4. Properly connect the battery.
5. Start the engine and run at approximately 1/3-1/2 throttle for about one minute, without moving the machine or operating any hydraulic functions.
6. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

7. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.

8. Close and secure the battery and engine covers.
9. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

d. Steering Test

1. Start the machine and select either the 4-wheel steer or the crab steer mode.
2. Turn the steering wheel until the left rear wheel is aligned with the side of the frame.
3. Select the 2-wheel steer mode and turn the steering wheel until the left front wheel is aligned with the frame.
4. With the wheel now aligned, select the desired steer mode.
5. If further troubleshooting is required, refer to Section 8.6.5, “Steering Pressure Checking,” Section 8.7, “Hydraulic Schematic,” or Section 9.4, “Electrical System Schematics.”

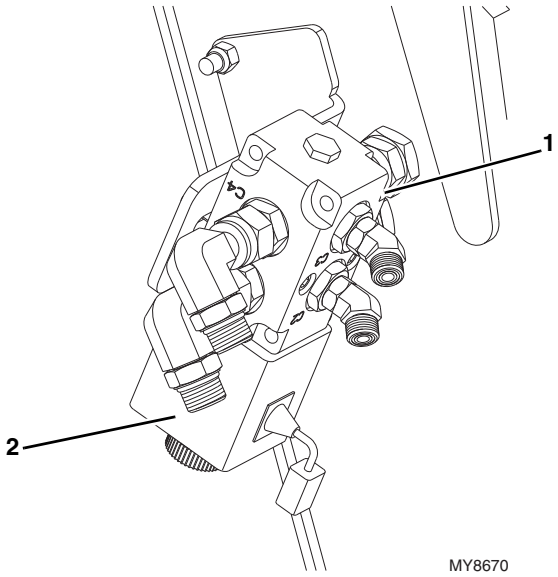
8.11.10 Quick Attach Valve

The quick attach valve is located on the left side of the boom head.

Verify the correct operation of the quick attach valve solenoid before considering replacement of the valve. The housing of the quick attach valve is not serviceable and must be replaced if defective.

a. Quick Attach Valve Removal

1. Park the machine on a firm, level surface, fully retract the boom, raise the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Label or otherwise mark the hydraulic hoses in relation to the quick attach valve (**1**). Disconnect and cap all hoses, fittings, solenoid wire terminal leads, etc.
6. Remove the quick attach valve from the machine. Wipe up any hydraulic fluid spillage in, on, near and around the machine.

b. Quick Attach Valve Disassembly, Cleaning, Inspection and Assembly

1. Place the quick attach valve assembly on a suitable work surface.
2. Remove the solenoid valve and cartridge (**2**) from the quick attach valve housing.
3. Clean all components with a suitable cleaner before inspection.
4. Inspect the solenoid cartridge for proper operation. Check by shifting the spool to ensure that it is functioning properly. Check that the spring is intact. Inspect the cartridge interior for contamination.
5. Inspect internal passageways of the decompression valve for wear, damage, etc. If inner surfaces of the manifold **DO NOT** display an ultra-smooth, polished finish, or components are damaged in any way, replace the manifold or appropriate part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the unit.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

6. Install the solenoid valve and cartridge in the quick attach valve housing.

c. Quick Attach Installation

1. Attach the quick attach valve to the fittings on the boom head.
2. Connect the hydraulic hoses, fittings, solenoid wire terminal leads, etc., to the quick attach.
3. Properly connect the battery.
4. Start the engine and run at approximately 1/3-1/2 throttle for about one minute, without moving the machine or operating any hydraulic functions.
5. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

6. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
7. Close and secure the battery and engine covers.
8. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

d. Quick Attach Valve Test

1. Turn the ignition switch to the ON position, activate the quick attach switch to switch the auxiliary position or the quick attach position.
2. If further troubleshooting is required, refer to Section 8.7, “Hydraulic Schematic,” or Section 9.4, “Electrical System Schematics.”

8.11.11 Variable Speed Fan Valve

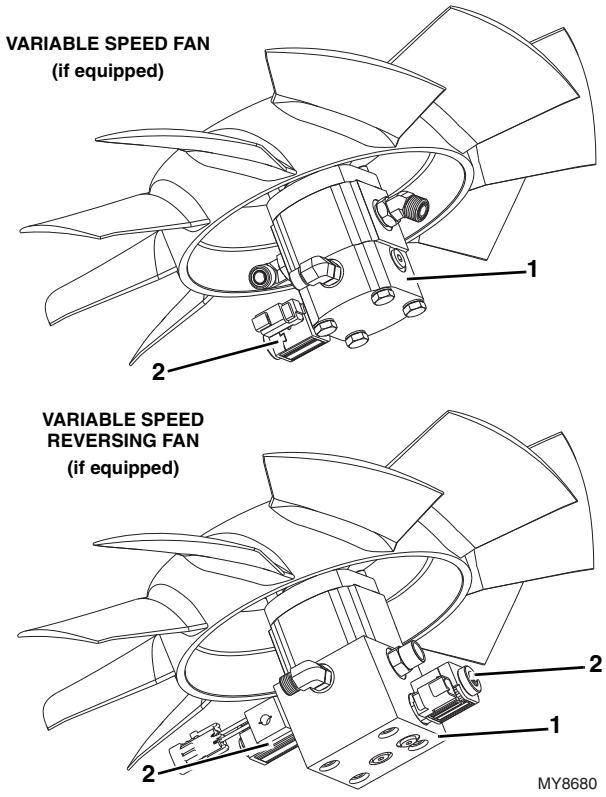
The variable speed fan valve is located on the bottom side of the Radiator assembly.

Place a piece of paper over the face of the radiator core. If the paper is held in place, the fan is rotating in the right direction.

The housing of the variable fan valve is not serviceable and must be replaced if defective.

a. Variable Speed Fan Valve Removal

1. Park the machine on a firm, level surface, fully retract the boom, raise the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Properly support the boom.
3. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
4. Open the battery and engine covers. Allow the system fluids to cool.
5. Properly disconnect the battery.
6. Refer to Section 7.2.2, “Radiator/Oil Cooler Replacement,” for detailed removal instructions.



7. Label or otherwise mark the hydraulic hoses in relation to the variable speed fan valve (**1**). Disconnect and cap all hoses, fittings, solenoid wire terminal leads, etc.
8. Remove the variable speed fan valve from the machine. Wipe up any hydraulic fluid spillage in, on, near and around the machine.

b. Variable Speed Fan Valve Disassembly, Cleaning, Inspection and Assembly

1. Place the variable speed fan valve assembly on a suitable work surface.
2. Remove the solenoid valve and cartridge (**2**) from the variable speed fan valve housing.
3. Clean all components with a suitable cleaner before inspection.

4. Inspect the solenoid cartridge for proper operation. Check by shifting the spool to ensure that it is functioning properly. Check that the spring is intact. Inspect the cartridge interior for contamination.
5. Inspect internal passageways of the variable speed fan valve for wear, damage, etc. If inner surfaces of the manifold **DO NOT** display an ultra-smooth, polished finish, or components are damaged in any way, replace the manifold or appropriate part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the unit.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

6. Install the solenoid valve and cartridge in the variable speed fan valve housing.

c. Variable Speed Fan Valve Installation

1. Connect the hydraulic hoses, fittings, solenoid wire terminal leads, etc., to the variable fan valve.
2. Refer to Section 7.2.2, “Radiator/Oil Cooler Replacement,” for detailed installation instructions.
3. Properly connect the battery.
4. Start the engine and run at approximately 1/3-1/2 throttle for about one minute, without moving the machine or operating any hydraulic functions.
5. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

6. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
7. Close and secure the battery and engine covers.
8. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

d. Variable Speed Fan Valve Test

1. Turn the ignition switch to the ON position, activate the variable speed fan switch to the ON position.
2. Place a piece of paper over the face of the radiator core. If the paper is held in place, the fan is rotating in the right direction.
3. If further troubleshooting is required, refer to Section 8.7, “Hydraulic Schematic,” or Section 9.4, “Electrical System Schematics.”

8.12 HYDRAULIC CYLINDERS

8.12.1 General Cylinder Removal Instructions

1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Chock the wheels.
3. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
4. Open the battery and engine covers. Allow the system fluids to cool.
5. Properly disconnect the battery.
6. Label, disconnect and cap hydraulic hoses in relation to the cylinder.
7. Attach a suitable sling to an appropriate lifting device and to the cylinder. Make sure the device used can actually support the cylinder.
8. Remove the lock bolt and/or any retaining clips securing the cylinder pins. Remove the cylinder pins.
9. Remove the cylinder.
10. Wipe up any hydraulic fluid spillage in, on, near or around the machine.

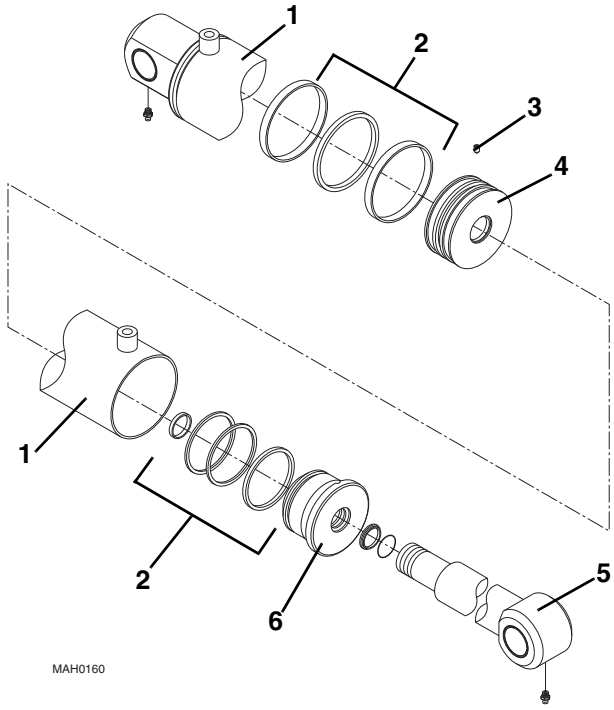
8.12.2 General Cylinder Disassembly

1. Clean the cylinder with a suitable cleaner before disassembly. Remove all dirt, debris and grease from the cylinder.
2. Clamp the barrel end of the cylinder in a soft-jawed vise or other acceptable holding equipment if possible.

NOTICE

Avoid using excessive force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube.

3. If applicable, remove the counterbalance valve from the side of the cylinder barrel.



NOTICE

DO NOT tamper with or attempt to adjust the counterbalance valve cartridge. If adjustment is necessary, replace the counterbalance valve with a new part.

4. Extend the rod (**5**) to allow access to the base of the cylinder.

NOTICE

Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.

5. Using a pin spanner wrench, unscrew the head gland (**6**) from the barrel (**1**). A considerable amount of force will be necessary to remove the head gland. Carefully slide the head gland down along the rod toward the rod eye end, away from the cylinder barrel.

NOTICE

When sliding the rod and piston assembly out of the tube, prevent the threaded end of the tube from damaging the piston. Keep the rod centered within the tube to help prevent binding.

6. Carefully pull the rod assembly along with the head gland out of the cylinder barrel.
7. Fasten the rod end in a soft-jawed vise, and put a padded support under and near the threaded end of the rod to help prevent damage to the rod.
8. Remove the set screw (**3**) from the piston (**4**).

Note: *It may be necessary to apply heat to break the bond of the sealant between the piston and the rod before the piston can be removed.*

Some cylinder parts are sealed with a special organic sealant and locking compound. Before attempting to disassemble these parts, remove any accessible seals from the area of the bonded parts. Wipe off any hydraulic oil, then heat the part(s) uniformly to break the bond. A temperature of 300-400° F (149-204° C) will destroy the bond. Avoid overheating, or the parts may become distorted or damaged. Apply sufficient torque for removal while the parts are still hot. The sealant often leaves a white, powdery residue on threads and other parts, which must be removed by brushing with a soft brass wire brush prior to reassembly.

9. Remove the piston head (**4**) from the rod (**5**) and carefully slide the head gland (**6**) off the end of the rod.
10. Remove all seals, back-up rings and o-rings (**2**) from the piston head and all seals, back-up rings and o-rings from the head gland.

Note: *The head gland bearing will need to be inspected to determine if replacement is necessary.*

DO NOT attempt to salvage cylinder seals, sealing rings or o-rings. ALWAYS use a new, complete seal kit when rebuilding hydraulic components. Consult the parts manual for ordering information.

8.12.3 Cylinder Cleaning Instructions

1. Discard all seals, back-up rings and o-rings. Replace with new items from complete seal kits to help ensure proper cylinder function.
2. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

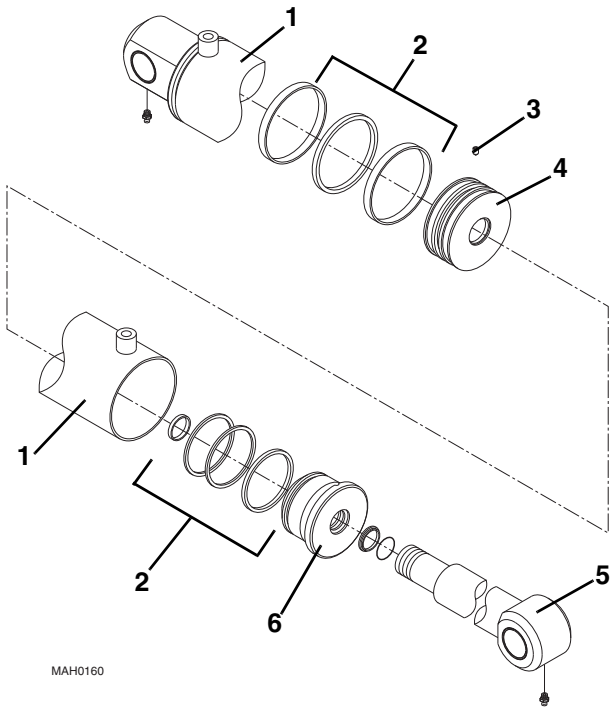
Note: *If a white powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe clean before reinstallation.*

8.12.4 Cylinder Inspection

1. Inspect internal surfaces and all parts for wear, damage, etc. If the inner surface of the tube does not display a smooth finish, or is scored or damaged in any way, replace the tube.
2. Remove light scratches on the piston, rod or inner surface of the tube with a 400-600 grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
3. Check the piston rod assembly for run-out. If the rod is bent, it must be replaced.

8.12.5 General Cylinder Assembly

1. Use the proper tools for specific installation tasks. Clean tools are required for assembly.



2. Install new seals, back-up rings and o-rings (**2**) on the piston (**4**) and the head gland (**6**).

Note: *The Crowd cylinder has a spacer that MUST be installed over the rod AFTER the head gland and BEFORE the piston head.*

3. Fasten the rod eye in a soft-jawed vise, and place a padded support under and near the threaded end of the rod (**5**) to prevent any damage to the rod.

NOTICE

Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.

4. Lubricate and slide the head gland (**6**) over the cylinder rod (**5**). Install the piston head (**4**) on to the end of the cylinder rod. Loctite® 243™ and install the setscrew (**3**) in the piston head. Refer to Section 8.12.8, "Hydraulic Cylinder Torque Specifications," for tightening guidelines for the piston head and the set screw.

NOTICE

Avoid using excessive force when clamping the cylinder barrel in a vise. Apply only enough force to hold the cylinder barrel securely. Excessive force can damage the cylinder barrel.

5. Place the cylinder barrel (**1**) in a soft-jawed vise or other acceptable holding equipment if possible.

NOTICE

When sliding the rod and piston assembly into the cylinder barrel, prevent the threaded end of the cylinder barrel from damaging the piston head. Keep the cylinder rod centered within the barrel to prevent binding.

6. Carefully insert the cylinder rod assembly into the tube.
7. Screw the head gland (**6**) into the cylinder barrel (**1**) and tighten with a spanner wrench. Refer to Section 8.12.8, "Hydraulic Cylinder Torque Specifications," for tightening guidelines for the head gland.
8. If applicable, thread the new counterbalance valve into the block on the cylinder barrel.

8.12.6 General Cylinder Installation

1. Grease the bushings at the ends of the hydraulic cylinder. Using an appropriate sling, lift the cylinder into it's mounting position.
2. Align cylinder bushing and install pin, lock bolt or retaining clip.
3. Uncap and connect the hydraulic hoses in relation to the labels or markings made during removal.
4. Before starting the machine, check fluid level of the hydraulic fluid reservoir and if necessary, fill to full mark.
5. Properly connect the battery.
6. Start the machine and run at low idle for about one minute. Slowly activate hydraulic cylinder function in both directions allowing cylinder to fill with hydraulic oil.
7. Inspect for leaks and check level of hydraulic fluid in reservoir. Add hydraulic fluid if needed.
8. If no leaks are present, operate the hydraulic function at least twenty times at full throttle to bleed any air from the cylinder and hoses.

Note: *To bleed air from the tilt cylinder, operate the tilt function along with the lift cylinder as described above. More operation cycles may be required to clear all air from the system.*

9. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
10. Close and secure the battery and engine covers.
11. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

8.12.7 Steering Cylinders

The steering cylinders are attached to each axle center housing. Detailed axle service instructions are provided in the Axle Disassembly & Assembly Manual (P/N 31200451).

8.12.8 Hydraulic Cylinder Torque Specifications

a. Lift Lower Cylinder

Head	Piston	CB Valve	Valve Screw	FC Valve	Set Screw
300-400 lb-ft (406-542 Nm)	1800-2000 lb-ft (2440-2712 Nm)	45-50 lb-ft (61-67,7 Nm)	20-25 lb-ft (27-33,8 Nm)	30-35 lb-ft (40,6-47,5 Nm)	11 lb-ft (15 Nm)

b. Extend/Retract Cylinder

Head	Piston	Valve	Valve Screw	Set Screw
200-250 lb-ft (271-339 Nm)	200-240 lb-ft (271-325 Nm)	44 lb-ft (60 Nm)	10-12 lb-ft (14-16 Nm)	60-69 lb-ft (81-94 Nm)

c. Tilt Cylinder

Head	Piston	Valve	Valve Screw	Set Screw
300-400 lb-ft (406-542 Nm)	1400-1500 lb-ft (1898-2034 Nm)	44 lb-ft (60 Nm)	10-12 lb-ft (14-16 Nm)	11 lb-ft (15 Nm)

d. Compensating Cylinder

Head	Piston	Valve	Valve Screw	Set Screw
300-400 lb-ft (406-542 Nm)	1400-1500 lb-ft (1898-2034 Nm)	44 lb-ft (60 Nm)	10-12 lb-ft (14-16 Nm)	11 lb-ft (15 Nm)

Use Loctite® 262™ on all Piston Applications
Use Loctite® 242™ on all Set Screws

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Section 9
Electrical System

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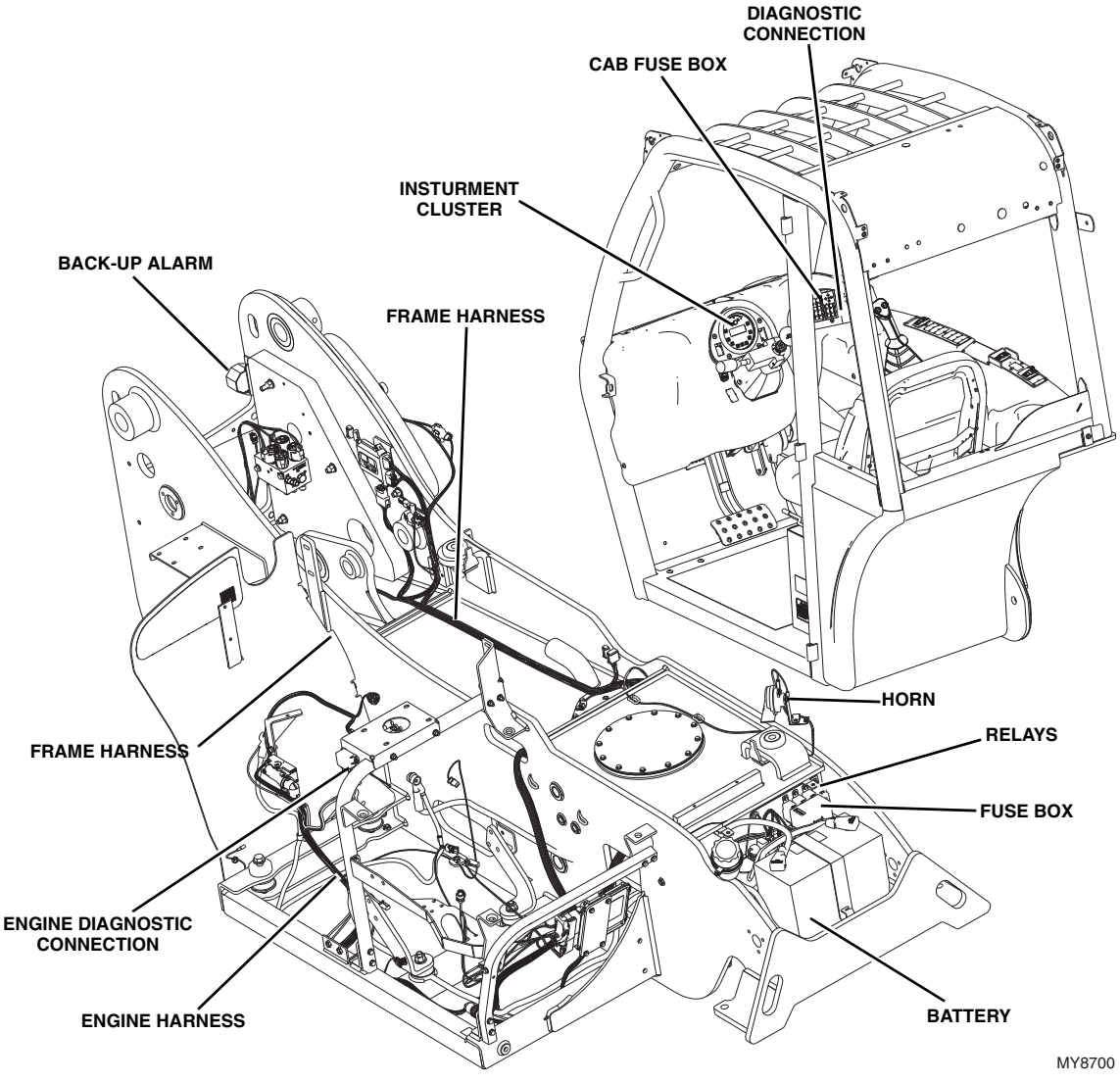
9.1 ELECTRICAL COMPONENT TERMINOLOGY

To understand the safety, operation, and service information presented in this section, it is necessary that the operator/mechanic be familiar with the name and location of the electrical components of the machine. The following illustration identifies the components that are referred to throughout this section.



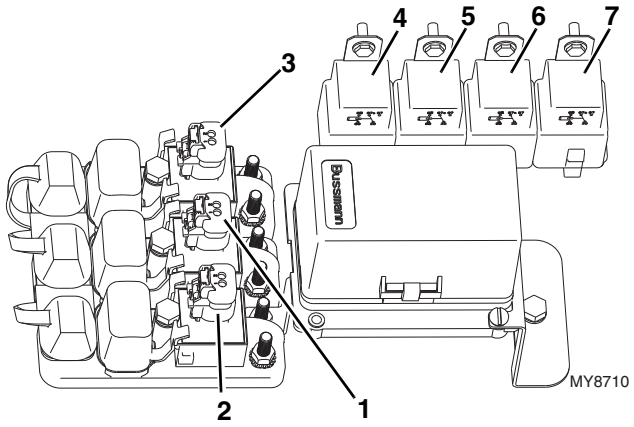
9.2 SAFETY INFORMATION

WARNING

DO NOT service the machine without following all safety precautions as outlined in the “Safety Practices” section of this manual.

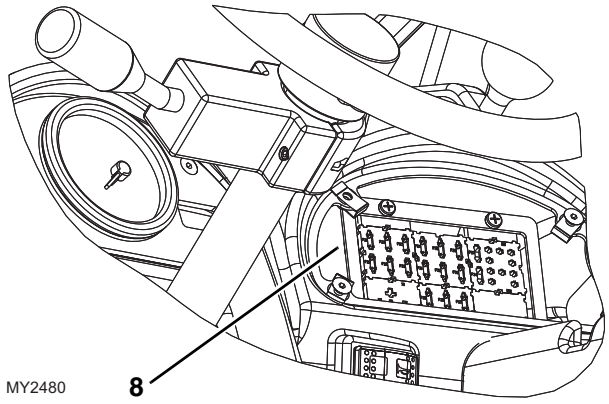
9.3 FUSES AND RELAYS

9.3.1 Engine Compartment Relays and Fuses



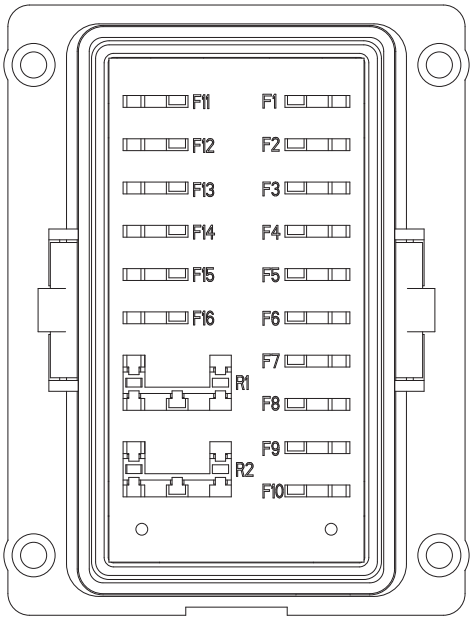
There are seven relays and one buss bar located on the frame, mounted on a bracket behind the battery. The relays control the auxiliary (**1**), ignition (**2**), fuel pump (**3**), Cut Out (**4**), Auxiliary (**5**) and Joystick (**6** & **7**).

9.3.2 Cab Compartment Fuses and Relays



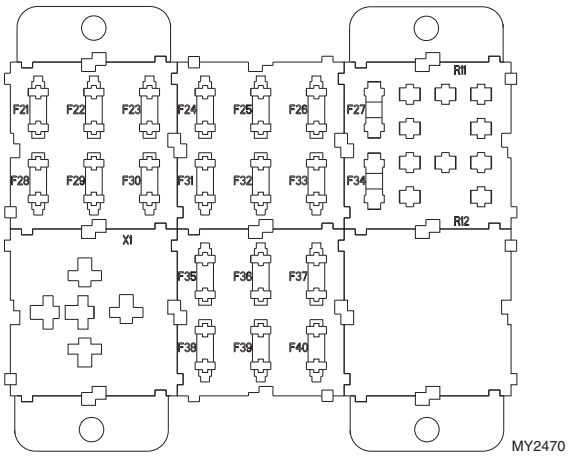
The cab fuse block (**8**) is located behind an access panel at the right side of the dash.

9.3.3 Power Distribution Module



Fuse/Relay	Function	Amp Rating
F1	Drive Cut-Out	15
F2	Auxiliary Circuit	15
F3	Display	5
F4	Joystick	5
F5	System Module	15
F6	ClearSky	5
F7	Back-Up Alarm, Reverse Light	15
F8	Beacon	10
F9	LSI System	10
F10	ECM	15
F11	Key	10
F12	ClearSky	5
F13	Rear Power & Horn	15
F14	Front Worklights	10
F15	Boom Worklights	10
F16	Rear Worklights	10
R1	Worklights	35
R2	Back-Up Alarm, Reverse Light	35

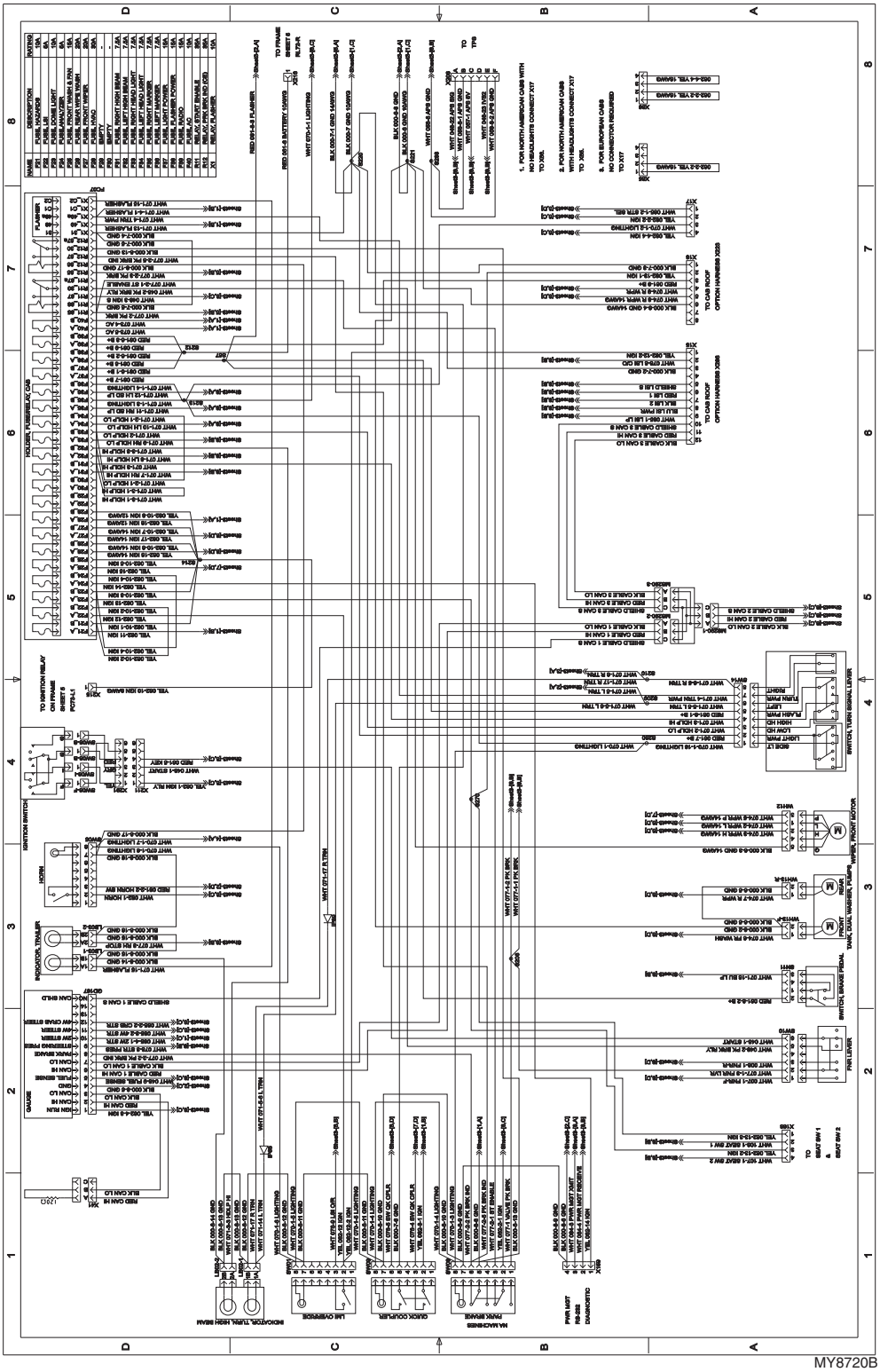
9.3.4 Cab Fuses / Relays



Fuse/Relay	Function	Amp Rating
F21	Hazard	10
F22	LSI Over Ride	5
F23	Dome Light	10
F24	Analyzer	5
F25	Front Washer & Fan	15
F26	Rear Roof Wiper	20
F27	Front Wiper	20
F28	HVAC Switch	30
F29	Spare	
F30	Spare	
F31	Right Headlight - High Beam	7.5
F32	Left Headlight - High Beam	7.5
F33	Right Headlight - Low Beam	7.5
F34	Left Headlight - Low Beam	7.5
F35	Right Marker Lights - Trailer Light Connection	7.5
F36	Left Marker Lights - License Light - Trailer Connection	7.5
F37	Turn Signal Switch	15
F38	Brake Pedal Switch	15
F39	Radio	15
F40	HVAC Switch - AC	10
R11	Relay - Start Enable	35
R12	Park Brake Switch (CE)	35
X1	Flasher	10

9.4 ELECTRICAL SYSTEM SCHEMATICS

a. Cab Schematic "A"



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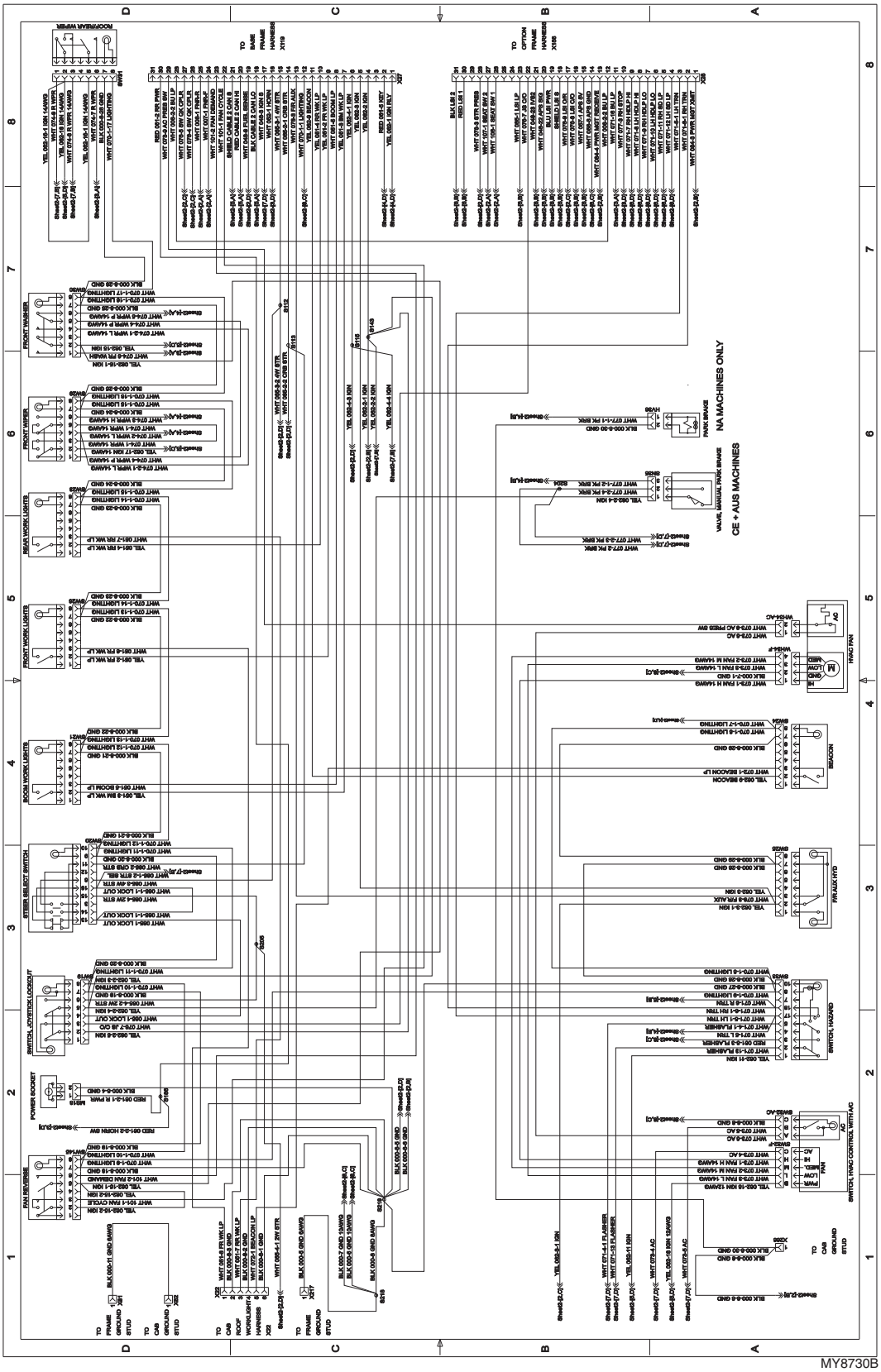
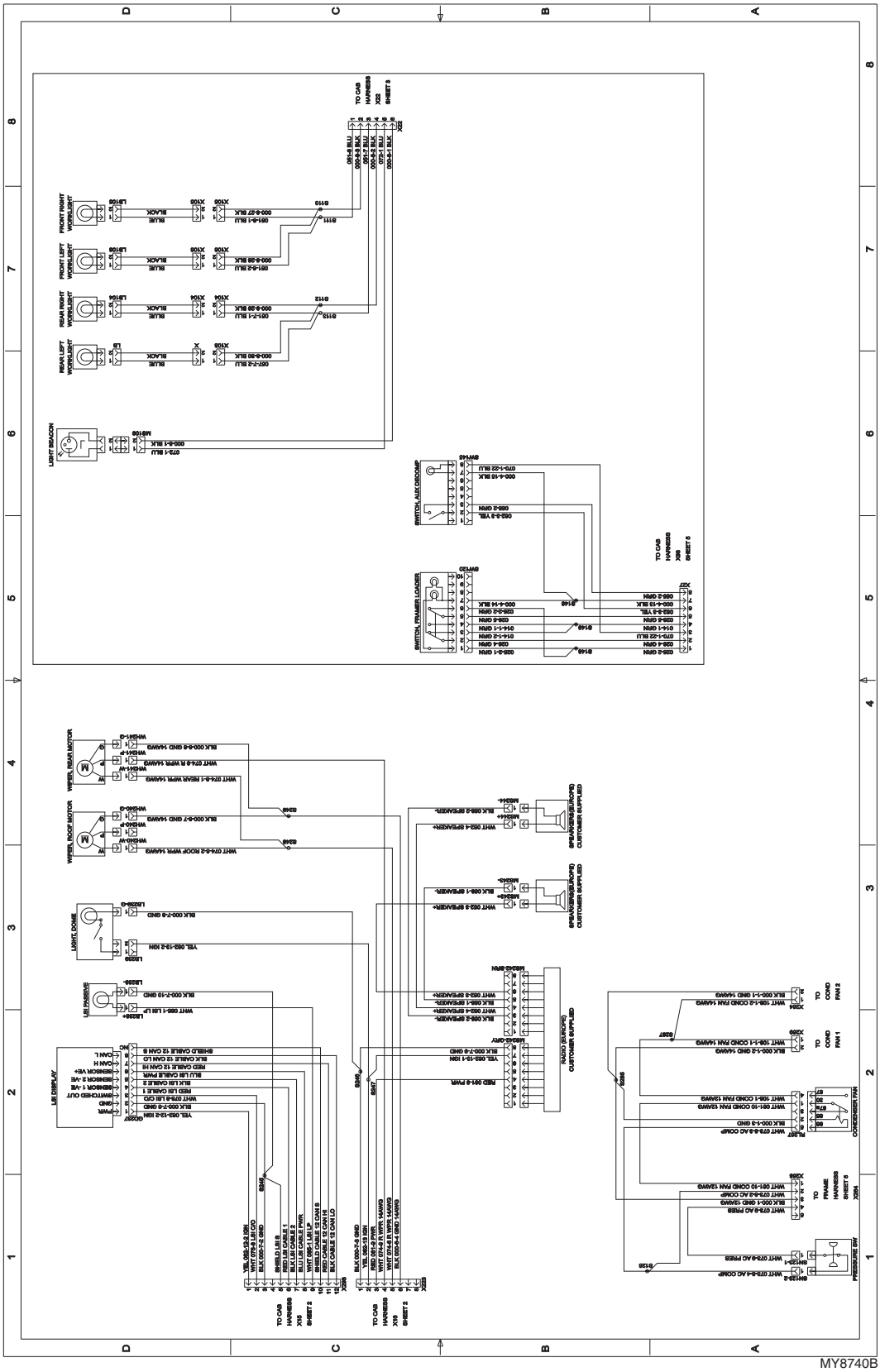
b. Cab Schematic "B"



c. Cab Roof, AC and Miscellaneous Schematic



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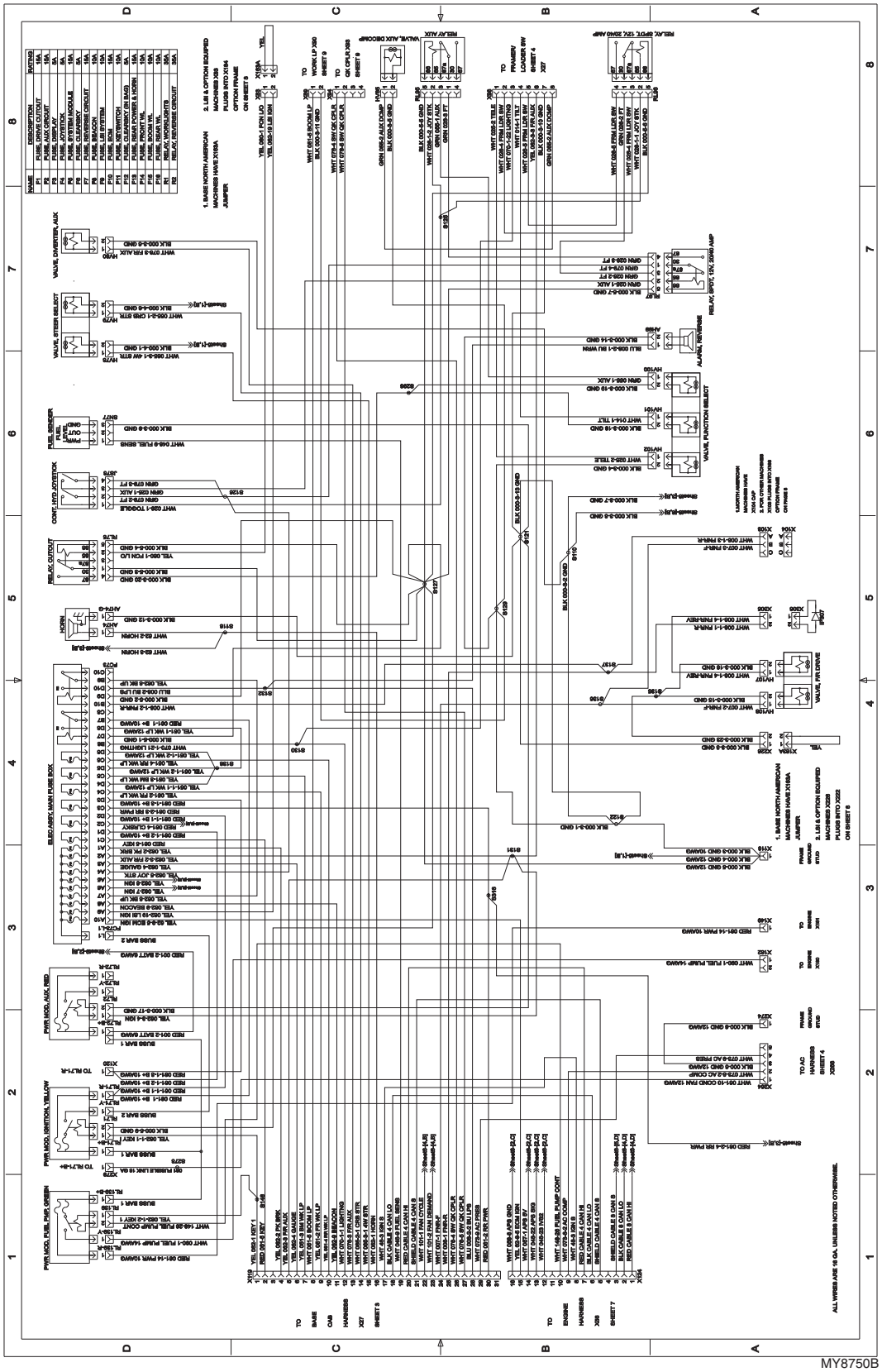
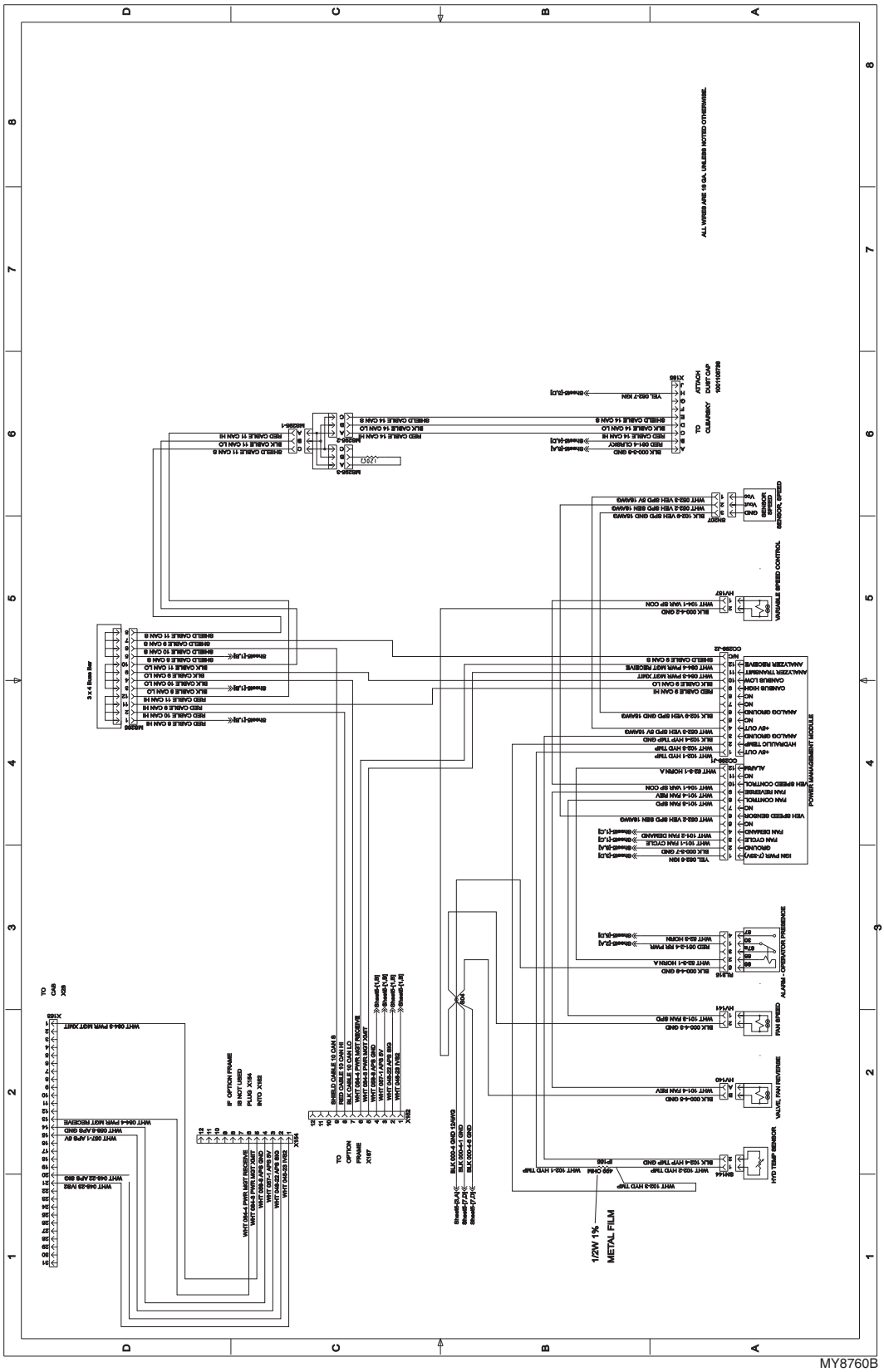
d. Base Frame Schematic "A"



MY8750B

e. Base Frame Schematic "B"



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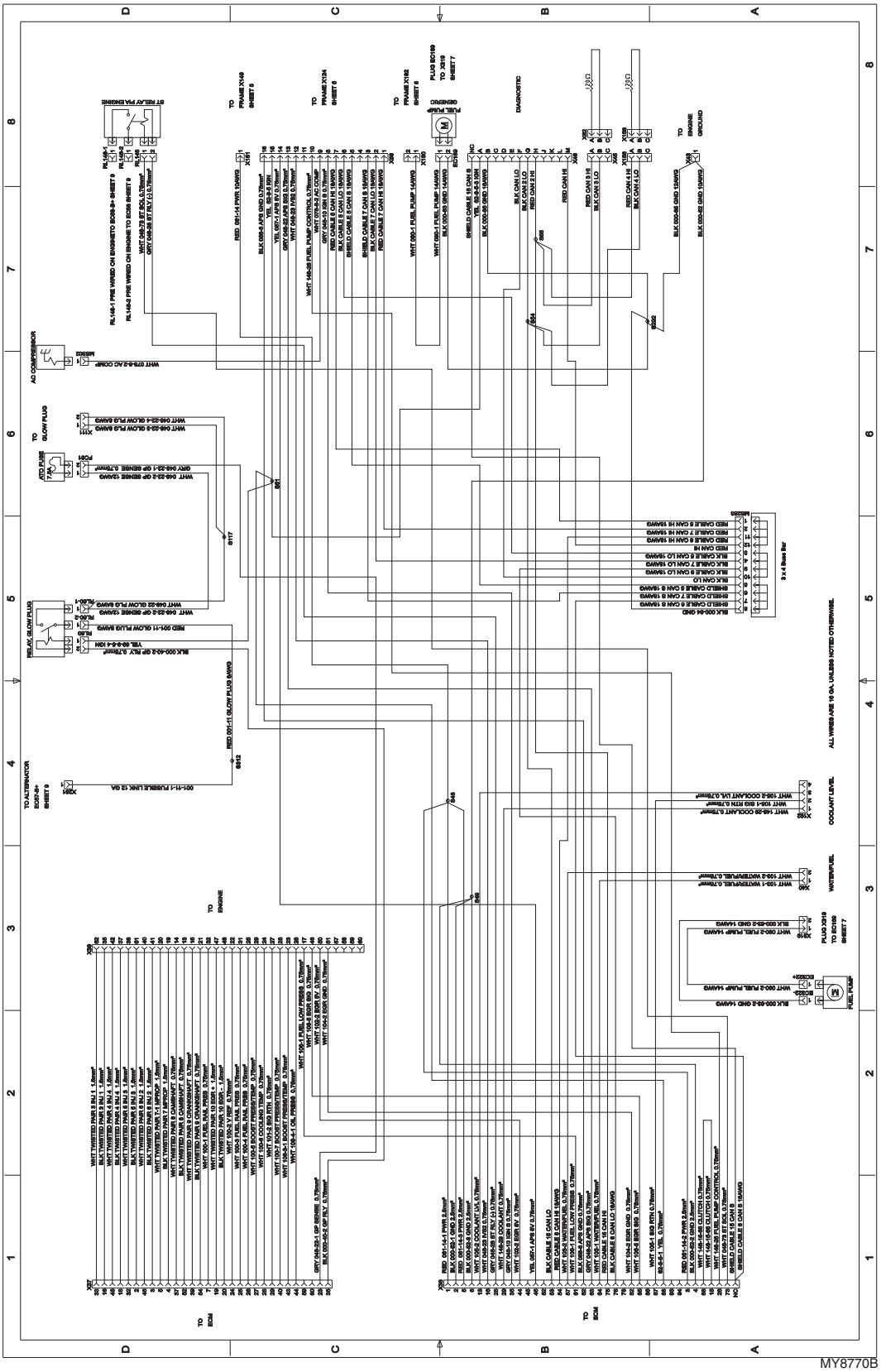
f. Engine Schematic



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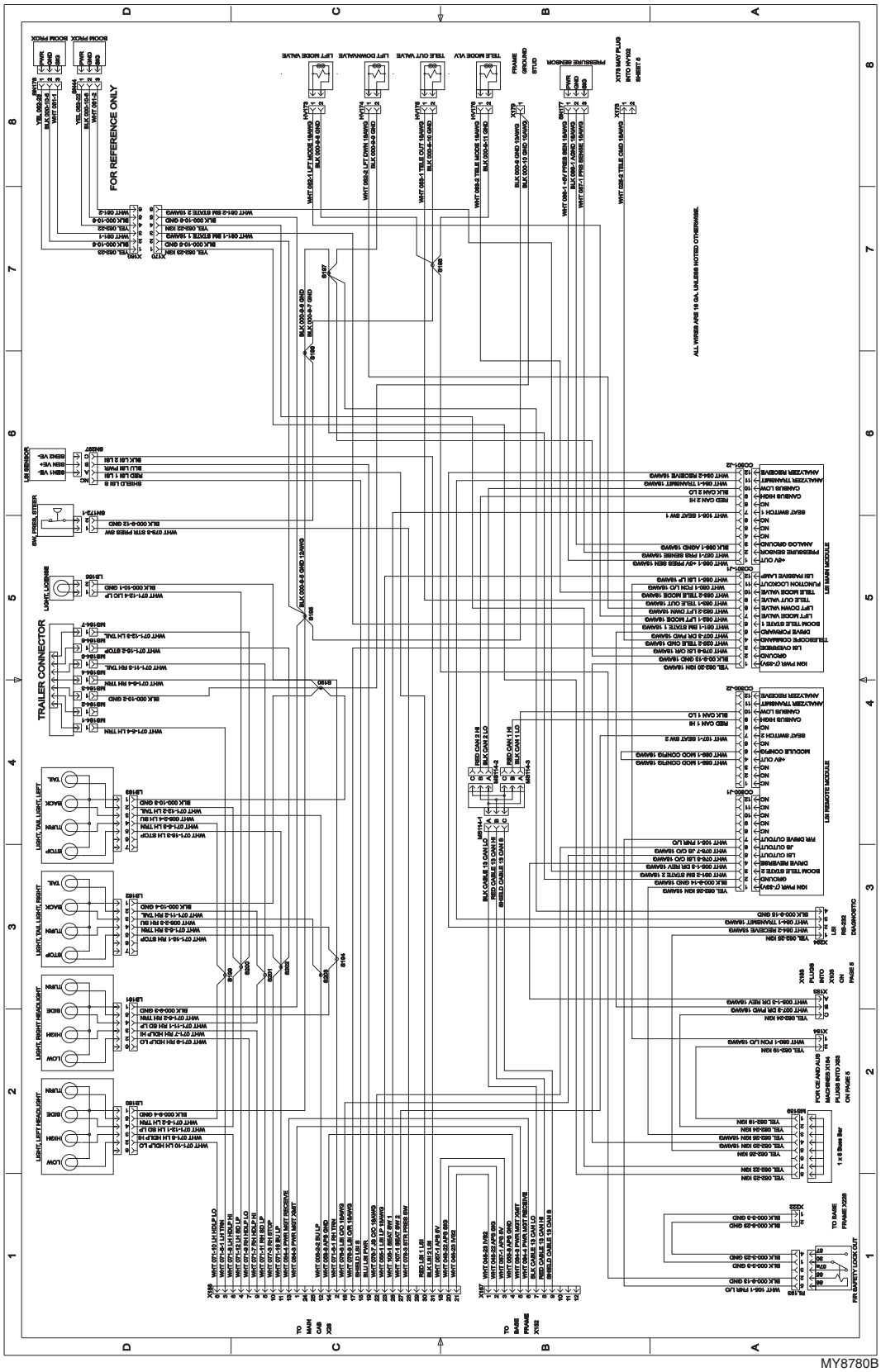
g. Option Frame Schematic



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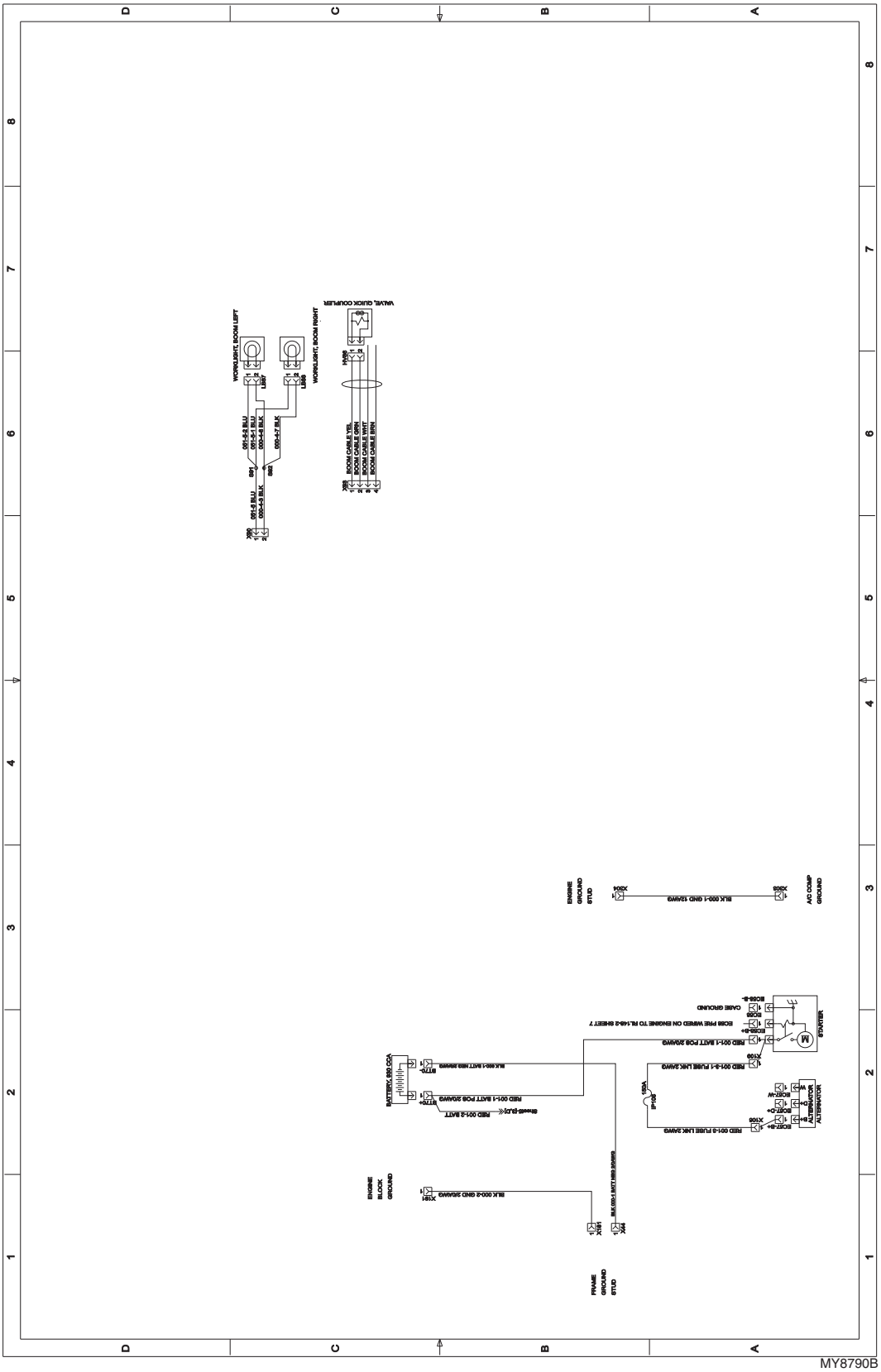
h. Cables and Boom Schematic



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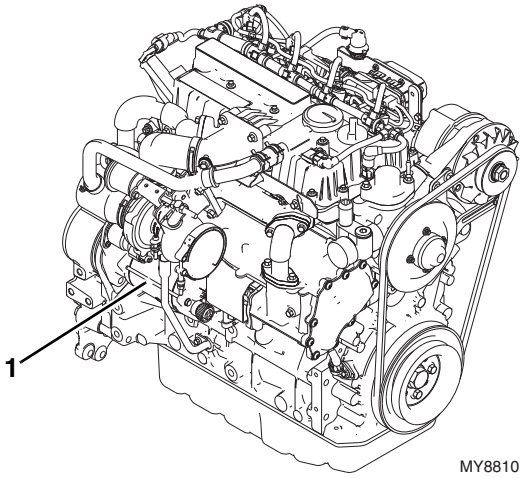
9.5 ENGINE START CIRCUIT

9.5.1 Starter



The starter (**1**) is located on the right side of the engine attached to the bell housing.

a. Testing the Starter on the Engine

Note: *The operator must be sitting on the seat to enable the starting circuit.*

If the starter does not engage when the ignition key switch is turned, check the following:

1. The transmission control lever is in (N) NEUTRAL and the park brake switch is set.
2. The main fuse may be blown, requiring replacement. Check for the cause of the blown fuse.
3. There may be a defect in the ignition key switch, ignition wiring or starter solenoid.
4. Check battery condition. Clean the battery posts and the connectors at each end of the battery cables.
5. Check for broken wiring and damaged insulation on the wiring. Replace all broken or damaged wiring.
6. Check all connections at the starter solenoid, key switch and wiring harness plugs. Clean and tighten all connections.
7. If the starter still does not operate after these checks have been performed, check the starting circuit.

b. Starter Circuit Checks

1. Check wires and connections for looseness, corrosion, damage, etc.
2. If a “whirring” noise is heard but the engine does not turn over, the starter is spinning but not engaging the flywheel. The starter drive or solenoid that pushes the drive forward to engage the flywheel may be defective. Missing or damaged teeth on the flywheel can also prevent the starter from cranking the engine.
3. If the starter only “clicks” it may indicate that the battery is discharged, or that there is a loose or corroded battery cable connection. Check the battery state of charge and battery condition first, then check the cables and cable connections.
4. For additional information on the starting circuit, refer to Section d, “Base Frame Schematic "A"."

c. Starter Removal

Remove the starter only if it fails. To remove the starter:

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.

Note: *Park the machine on blocks to allow proper access under the machine.*

2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the engine to cool.
4. Properly disconnect the battery.
5. Remove the belly pan.
6. Disconnect and remove the air intake hose.
7. Disconnect and remove the exhaust tube between the turbocharger and muffler.
8. Disconnect the two connectors on the ECM.
9. Disconnect the diagnostic plug from the air cleaner bracket and remove the nylon ties securing the wire harness to the rear fender.
10. Loosen and remove the side skirt on the engine pod.
11. Loosen and remove the rear fender along with the air cleaner.
12. Disconnect the plug from the bracket and remove the bracket from the engine.
13. Loosen and remove the turbocharger drain tube.
14. Plug or cap the turbocharger drain tube openings to prevent dirt and/or debris from entering the engine.

Note: *Replace the o-ring at the base of the turbocharger drain tube during re-assembly.*

15. Remove the positive cables from the starter.

16. Remove the top bolt securing the starter to the engine.

Note: *Use a 13mm deep well socket on a 6 in extension to remove the top starter mounting bolt.*

17. Remove the bottom bolt securing the starter to the engine.
18. Remove the starter (**1**) from the machine.

d. Starter Cleaning and Drying

1. While the starter is being removed, wipe away any grease or dirt that has accumulated around the starter mounting opening.
2. If reinstalling the starter, clean the exterior of the starter with an approved solvent. **DO NOT** submerse the starter or allow the solvent to contact the starter bushings.
3. Dry the starter with a clean, lint-free cloth.

e. Starter Periodic Maintenance

A starter requires no routine maintenance beyond the occasional inspection of the electrical connections, which must be clean and tight.

Note: ***DO NOT*** *disassemble the starter. The starter is not serviceable and must be replaced in its entirety, if defective.*

f. Starter Installation

1. Position the starter in its mounting opening on the flywheel housing. Install the bottom bolt securing the starter to the flywheel housing.

Note: *Do Not tighten the bottom bolt until the top bolt is installed.*

2. Using tape or a magnetic socket, secure the top starter mounting bolt to the socket. Install the top bolt securing the starter to the flywheel housing.
3. Tighten and torque the starter mounting bolts to 25Nm (18 lb-ft).
4. If necessary, install a new o-ring on the turbocharger drain tube.
5. Remove the plugs or caps from the turbocharger drain tube openings.
6. Install the turbocharger drain tube to the engine. Torque the turbocharger drain tube mounting bolt to 8.5 Nm (7 lb-ft).
7. Install the previously removed bracket to the engine and connect the electrical connector.
8. Install the previously removed rear fender along with the air cleaner to the engine pod.
9. Install the previously removed side skirt on the engine pod.
10. Connect the diagnostic plug to the air cleaner bracket and securing the wire harness to the rear fender.
11. Connect the two connectors on the ECM.
12. Install the previously removed exhaust tube between the turbocharger and muffler. Tighten as required.
13. Install the previously removed air intake hose. Tighten as required.
14. Install the previously removed belly pan. Tighten as required.
15. Properly connect the battery.
16. Close and secure the battery and engine covers.
17. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

9.6 CHARGING CIRCUIT

Before using a battery charger, an attempt can be made to recharge the battery by jump-starting the machine. (Refer to the appropriate Operation & Safety Manual.) Allow the engine to run, which will enable the alternator to charge the battery.

If the cab gauge shows an alternator issue, perform the following checks:

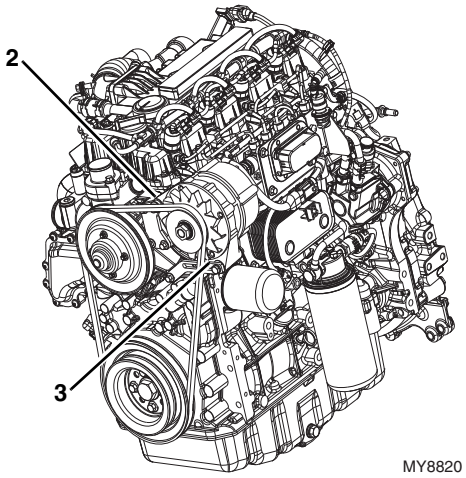
1. Check the all battery cable connections at the battery, and verify that they are clean and tight.
2. Check the external alternator wiring and connections, and verify that they are in good condition.
3. Check the fan belt condition and tension.
4. Verify that the alternator mounting hardware is tight.
5. Run the engine and check the alternator for noise. A loose drive pulley, loose mounting hardware, worn or dirty internal alternator bearings, a defective stator or defective diodes can cause noise. Replace a worn or defective alternator.

9.6.1 Alternator

a. Alternator Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the engine to cool.
4. Properly disconnect the battery.
5. Label and disconnect the wires attached to the alternator.

Note: *Record how the alternator is installed to ensure correct installation later.*



6. Loosen the top mounting bolt (**2**), but don't remove it at this time. This will allow the alternator to swivel during belt removal.
7. Loosen the belt tensioning adjustment bolt (**3**) at the bottom of the alternator to loosen the fan drive belt.
8. Remove the fan drive belt from the alternator.
9. Remove the lower mounting capscrew securing the alternator to the lower mounting hole on the engine.
10. While supporting the alternator with one hand, remove the upper mounting hardware from the upper alternator mount. Remove the alternator from the machine.

b. Alternator Installation

1. Position the alternator and align with the upper alternator mount on the engine bracket. Insert the upper mounting hardware through the alternator mount. **DO NOT** tighten completely at this time.
2. Align the lower alternator mount hole with the lower mounting bracket on the engine, and insert the lower mounting capscrew. Be sure to leave enough room to attach the drive belt.
3. Attach the fan drive belt to the alternator.
4. Adjust the lower belt tensioning bolt to remove excessive slack from the drive belt. Check for proper fan belt deflection.
5. Reattach the previously labeled electrical wires to the alternator.
6. Properly connect the battery.
7. Close and secure the battery and engine covers.
8. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

9.7 ELECTRICAL SYSTEM COMPONENTS

9.7.1 Back-up Alarm

The back-up alarm is located at the rear of the machine.

When the park brake is released and the transmission shift control switch (transmission control lever) is shifted to the (R) REVERSE position, the back-up alarm will automatically sound.

CE Only -

Place the transmission control lever in (R) REVERSE to test the back-up alarm. The back-up alarm must not sound when the transmission control lever is in (N) NEUTRAL or (F) FORWARD. Also, with the ignition key switch in the RUN position, the back-up alarm will sound when the transmission control lever is shifted into the (R) REVERSE position.

a. Disassembly

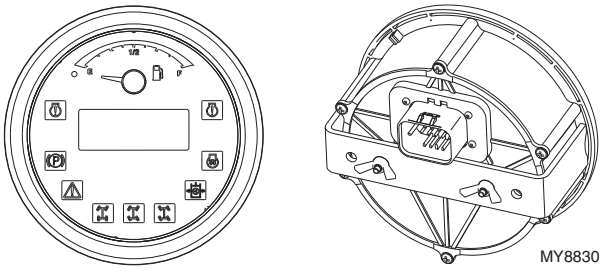
DO NOT disassemble the back-up alarm. Replace a defective or faulty alarm with a new part.

b. Inspection and Replacement

Inspect the wiring harness connector and alarm terminals for continuity and shorting. Test the alarm by turning the ignition key switch to the RUN position and shifting the transmission control lever into the REVERSE position. The alarm should sound.

Replace a defective or faulty alarm with a new part.

9.7.2 Gauge Cluster



a. Removal

NOTICE

Static electricity can cause damage to the operator's gauge. Avoid any manner of touching (hands, tools, etc.) the printed circuit boards and terminals. Disconnect the battery negative (-) cable at its battery terminal before beginning this procedure. Failure to comply can result in damage and/or malfunction of the gauge.

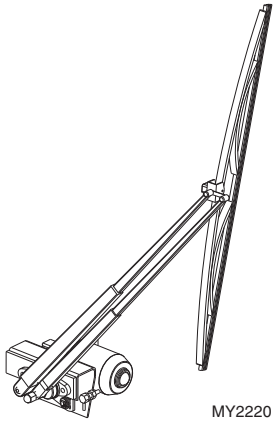
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the engine to cool.
4. Properly disconnect the battery.
5. Remove the screws holding the instrument panel to the dash.
6. Slide the instrument panel out of the operator console.
7. Disconnect the wiring harnesses from the rear of the gauge.
8. Remove the two wing nuts and bracket securing the gauge to the instrument panel.

b. Installation

1. Position the gauge in the instrument panel and secure with the previously removed bracket and wing nuts.
2. Connect the wiring harnesses to the rear of the gauge.
3. Position the instrument panel in the operator console.
4. Secure to the panel with four previously removed screws.
5. Properly connect the battery.
6. Close and secure the battery and engine covers.
7. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

9.8 WINDOW WIPER/WASHER

9.8.1 Windshield Wiper Motor



a. Removal

Note: *It may be necessary to remove several hydraulic hoses from under the dash in order to remove and install the wiper motor housing.*

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the engine to cool.
4. Properly disconnect the battery.
5. Remove the lower access panel below the instrument panel.
6. Disconnect the right side defroster hose from dash panel hose connector.
7. Disconnect the cab harness connectors from the wiper motor.
8. Remove the linkage attached to the wiper motor.
9. Loosen and remove the four bolts holding the wiper motor to the mounting bracket.

Note: *Retain all hardware removed from the wiper assembly for possible reuse on the replacement motor housing.*

10. Remove the motor from the inside of the cab.

b. Disassembly

DO NOT disassemble the motor. The motor is not serviceable. Replace motor if found to be defective.

c. Inspection and Replacement

Inspect the motor terminals for continuity. Replace motor if continuity is not found.

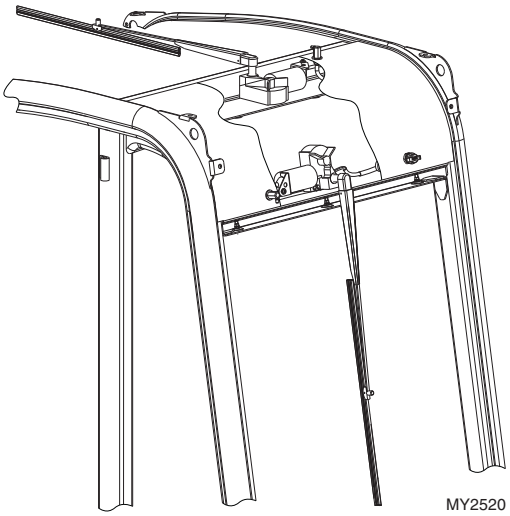
d. Installation and Testing

1. Install all required hardware to the motor assembly.
2. Align motor with the mounting holes and bolt the motor to the mounting bracket.
3. Connect the wiper linkage to the wiper motor shaft.

Note: *Align the wiper linkage arm with the flat on the motor shaft to ensure wiper stroke covers window area, and it does not swipe past the glass area.*

4. Connect the cab harness connectors to windshield wiper motor connectors.
5. Properly connect the battery.
6. Turn ignition key switch to the RUN position, and operate windshield wiper in both LOW and HIGH speeds to ensure proper operation and that correct wiper travel is achieved.
7. Install right side defroster hose to the dash panel hose connector.
8. If previously removed, install hydraulic hoses under the dash.
9. Install the lower dash panel.
10. Close and secure the battery and engine covers.
11. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

9.8.2 Rear Window or Roof Wiper Motor (if equipped)



a. Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the engine to cool.
4. Properly disconnect the battery.
5. Remove the wiper arm assembly.
6. Loosen and remove the rear wiper cover.
7. Disconnect the cab harness connectors from the wiper motor.
8. Remove the wiper motor in question.

Note: *Retain all hardware removed from the wiper assembly for possible reuse on the replacement motor housing.*

b. Disassembly

DO NOT disassemble the motor. The motor is not serviceable. Replace motor if found to be defective.

c. Inspection and Replacement

Inspect the motor terminals for continuity. Replace motor if continuity is not found.

d. Installation and Testing

1. Install all required hardware to the motor assembly.
2. Align motor with the mounting holes and bolt the motor to the proper location.

Note: *Align the wiper to ensure wiper stroke covers window area, and it does not swipe past the glass area.*

3. Connect the cab harness connectors to wiper motor connectors.
4. Install rear wiper cover.
5. Install wiper arm assembly.
6. Properly connect the battery.
7. Turn ignition key switch to the RUN position, and operate windshield wiper in both LOW and HIGH speeds to ensure proper operation and that correct wiper travel is achieved.
8. Install right side defroster hose to the dash panel hose connector.
9. If previously removed, install hydraulic hoses under the dash.
10. Install the lower dash panel.
11. Close and secure the battery and engine covers.
12. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

9.8.3 Windshield Washer Reservoir and Pump

The windshield washer motor and reservoir is located in the dash area as a unit and cannot be serviced separately.

a. Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the engine to cool.
4. Properly disconnect the battery.
5. Remove the nuts and the lockwashers from the washer mounting studs.
6. Pull the washer reservoir out and away from the mounting studs.

7. Rotate the washer reservoir, label and remove the cab harness connectors from the washer reservoir connectors.
8. Remove the windshield washer hoses from the reservoir.

b. Disassembly

DO NOT disassemble the pump. The pump is not serviceable. Replace pump if found to be defective.

c. Installation and Testing

1. Connect the windshield washer hoses to the reservoir.
2. Connect the cab wiring harness connectors to the reservoir connectors.
3. Install the reservoir tank onto the mounting studs.
4. Install the lockwashers and nuts and secure.
5. Fill the washer fluid reservoir with washer fluid.
6. Properly connect the battery.
7. Turn the ignition key switch to the RUN position and press the washer switch. Verify that fluid is sprayed on the windshield.
8. Close and secure the battery and engine covers.
9. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

9.9 CAB HEATER/AC AND FAN

9.9.1 Cab Heater/AC Controls

Note: *If the suspect component is found to be within the heater box, the heater box must be removed as a complete unit and replaced. For additional information on the removal and installation of the heater box, refer to Section 4.4.10, 4.4.10. "Heater/Defroster System (If Equipped)."*

The cab heater controls are located to the right of the seat. The control panel consists of a variable speed fan control knob and a temperature control knob.

a. Cab Heater Controls Removal

Note: *After determining which control knob is not functioning, remove only the suspect control knob. In order to remove either knob, the cab heater and fan control panel must be removed from the dash panel.*

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the engine to cool.
4. Properly disconnect the battery.
5. Remove the screws and backing locknuts from the cab heater and fan control panel.
6. Pull the control panel out from the dash panel, and if removing variable speed fan control, remove the cab harness connector.
7. If removing the temperature control knob, disconnect the cable connector and remove control knob.
8. Remove the setscrew from the variable speed fan control knob or temperature control knob.
9. Remove the hex locknut from the suspect control shaft.
10. Remove the control from the panel.

b. Disassembly

DO NOT disassemble the cab heater and fan controls. The controls are not serviceable. Replace controls if found to be defective.

c. Installation and Testing

1. Check that the variable speed fan control is in the OFF position.
2. If installing the temperature control, attach the cable connector to the back of the control.
3. Insert the control shaft through the panel, ensuring that the knob is in the VERTICAL position.
4. Install the hex locknut on the shaft and tighten.
5. Connect the cab harness connector to the variable speed fan control.
6. Install the control panel screws.
7. Install the setscrew, securing the knob to the control.
8. Properly connect the battery.
9. Turn the ignition key switch to the RUN position and fan switch. Verify that the fan operates at variable speeds.
10. Close and secure the battery and engine covers.
11. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

9.10 SWITCHES, SOLENOIDS AND SENDERS

9.10.1 Ignition Key Switch

a. Ignition Switch Removal

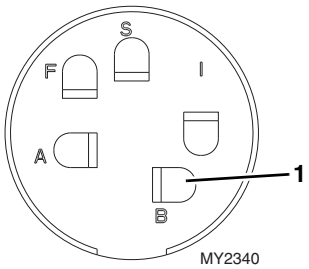
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the engine to cool.
4. Properly disconnect the battery.
5. Remove lower dash panel.
6. Remove the hex nut securing the ignition key switch to the dash.
7. Reach up under the dash to work the ignition switch and wiring out of the mounting hole.
8. Disconnect the ignition switch connectors from the cab harness connectors, and remove the switch from the machine.

b. Disassembly

DO NOT disassemble the ignition switch. Replace a defective switch with a new part.

c. Inspection and Replacement

To determine the proper operation of the ignition key switch, test the wires on the back of the switch for continuity with an ohmmeter.



Test the ignition key switch for continuity, by checking from the BAT terminal (**1**) to each of the remaining terminals in their corresponding switch position.

If all terminals do not show proper continuity, replace the ignition switch.

d. Ignition Switch Installation

1. Connect the ignition key switch to the cab harness connectors.
2. Reach up and under the dash to work the ignition switch into the ignition switch-mounting hole on the lower right side of the dash.
3. Align the ignition switch so that when it is in the OFF position, the key slot is positioned vertically (straight up and down). Install the hex nut securing the ignition switch to the dash. **DO NOT** overtighten.
4. Install the lower dash panel.
5. Properly connect the battery.
6. Turn the ignition key switch to the START position to verify proper operation.
7. Close and secure the battery and engine covers.
8. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

9.10.2 Dash Switches

a. Switch Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the engine to cool.
4. Properly disconnect the battery.
5. Pull the frame out of the dash, disconnect the harness connector to the switch in question and push the switch out of the frame.

b. Disassembly

DO NOT disassemble the dash switch. Replace a defective switch with a new part.

c. Inspection and Replacement

Inspect the switch terminals for continuity in both the engaged and disengaged positions. Replace a defective or faulty switch with a new switch.

d. Switch Installation

1. Connect the switch to the cab harness connector.
2. Position the switch over the rectangular switch bezel and snap into position.
3. Replace the frame into the dash.
4. Properly connect the battery.
5. Start the machine and check the replaced switch for proper function.
6. Close and secure the battery and engine covers.
7. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

9.10.3 Fuel Level Indicator and Fuel Level Sender

a. Fuel Level Indicator Testing

1. The fuel level sender wiring harness leads can be accessed from the top of the fuel tank. Disconnect the fuel level sender wiring harness leads. With the help of an assistant, touch both harness leads together.
2. From the operator's cab, have the assistant turn the ignition key switch to the RUN position. **DO NOT** start the engine. Observe the fuel level indicator needle on the operator's instrument cluster.
3. Turn the ignition key switch to the OFF position. The fuel level indicator needle should return to the EMPTY position.

b. Fuel Level Circuit Tests

If the fuel level indicator is suspected of giving a false reading, perform the following checks:

1. If the fuel level indicator needle does not move, check the fuel tank for fuel.
2. Check for loose or defective wiring, faulty ground connections or corrosion on the fuel tank sender and wiring lead.
3. If the fuel level indicator needle does not move after the ignition key switch is turned to the RUN position, use a test lamp to determine whether current is flowing from the ignition switch to the fuel level sender.
4. If the fuel level indicator does not move and a faulty or defective fuel level sender in the fuel tank has been ruled out and in addition, wiring and connectors have been checked and ruled out, the fuel level indicator is defective and the instrument cluster must be replaced.

5. Check that the ignition terminal has current and that the fuse in the fuse panel is not blown.
6. Check for broken, shorted, frayed, disconnected or damaged wiring between the fuel level indicator wiring at the cab, fuse and relay panel, ignition key switch and from the fuel level sender on the fuel tank through the wiring in the cab.
7. Check the fuel level sender. The resistance of the fuel level sender is 31 ohms for a full tank of fuel, 101 ohms for 1/2 tank and 255 ohms for an empty tank. A defective fuel level sender in the fuel tank may also prevent the fuel level indicator from moving.

9.10.4 Hourmeter

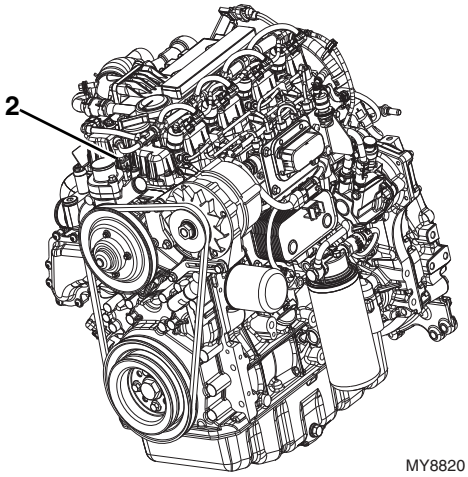
The hourmeter is a non-repairable instrument that records hours of machine engine operation in tenth of an hour increments and is located in the instrument cluster.

The hourmeter is an analog device, similar to an odometer, and will display 99,999.9 hours before resetting to zero.

If trouble is suspected, time the hourmeter for six minutes to verify that a tenth of an hour has been recorded.

The hourmeter is built into the instrument cluster and cannot be repaired. If the hourmeter is suspect, replace the instrument cluster.

9.10.5 Coolant Temperature Sender



The coolant temperature sender (**2**) is located on the top of the engine behind the top radiator hose.

a. Coolant Temperature Sender Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the engine to cool.
4. Properly disconnect the battery.
5. Disconnect the wiring connector at the coolant temperature sender lead.
6. The coolant temperature sender is threaded into the engine block. Remove the sender.

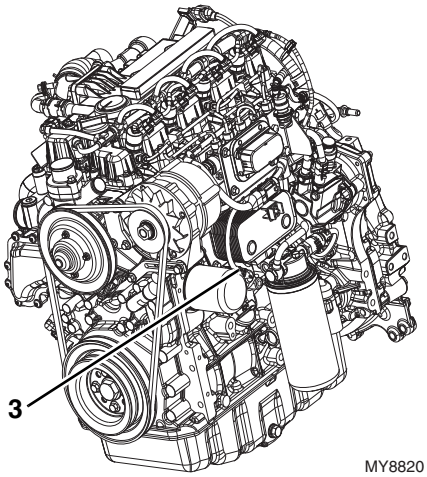
b. Coolant Temperature Sender Inspection and Replacement

Inspect the sender and the wiring harness connector terminals for continuity. Replace a defective or faulty sender with a new part.

c. Coolant Temperature Sender Installation and Testing

1. Thread the coolant temperature sender into the engine housing snugly, then connect the sender connector to the wiring harness connector.
2. Properly connect the battery.
3. Check for proper fluid level.
4. Start the engine, allow it to reach operating temperature and observe the operator's instrument cluster for warning indication. If the sender is not defective, the problem could be elsewhere; possibly in a shorted wire, improper-running engine, improper or low coolant, obstructed or faulty radiator, coolant pump, loose fan belt, defective instrument display, etc.
5. Close and secure the battery and engine covers.
6. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

9.10.6 Oil Pressure Sender



The oil pressure sender (**3**) is located on the engine near the oil filter.

a. Oil Pressure Sender Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the battery and engine covers. Allow the engine to cool.
4. Properly disconnect the battery.
5. Disconnect the wiring connector at the oil pressure sender lead.
6. The oil pressure sender is threaded into the engine. Remove the sender.

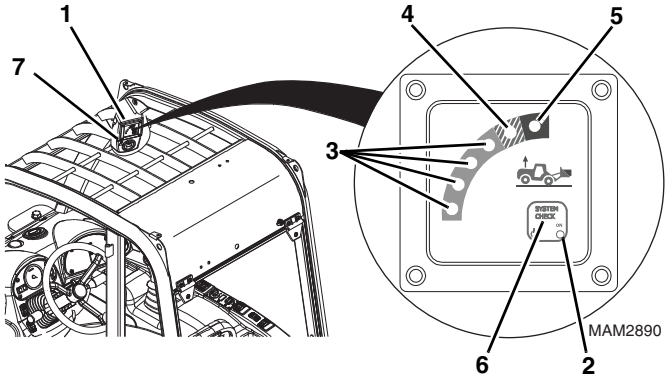
b. Oil Pressure Sender Inspection and Replacement

Inspect the sender and the wiring harness connector terminals for continuity. Replace a defective or faulty sender with a new part.

c. Oil Pressure Sender Installation and Testing

1. Thread the oil pressure sender into the engine housing snugly, then connect the sender connector to the wiring harness connector.
2. Properly connect the battery.
3. Check for proper fluid level.
4. Start the engine, and observe the operator's display for warning indication. If the sender is not defective, the problem could be elsewhere; possibly in a shorted wire, improper-running engine, low oil, obstructed or faulty oil pump, defective instrument display.
5. Close and secure the battery and engine covers.
6. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

9.11 LOAD STABILITY INDICATOR SYSTEM (2505H & 25.5)



The LSI (**1**) provides visual and audible indication of forward stability limitations when machine is static on firm, level surface.

- Green LED (**2**) will illuminate when LSI power is on.
- When approaching forward stability limitations LEDs progressively illuminate, green (**3**), then orange (**4**) and finally red (**5**).
- If the red LED iluminates, the warning buzzer also sounds.

The LSI has two modes:

Active Mode (CE & AUS)

- As the telehandler reaches forward stability limitations and the red LED (**5**) illuminates, the automatic function cut-out is activated. All boom functions are disabled except boom retract (CE & AUS) and boom lift (CE). Retract boom to fully re-enable functions.
- In some instances the LSI system may slow down or stop boom functions if operated close to forward stability limitations. When LEDs begin to flash, certain functions can not be operated. Retract boom and/or return the joystick to neutral position for a short period to allow system to reset and LEDs to stop flashing before proceeding with operation.

Passive Mode (CE)

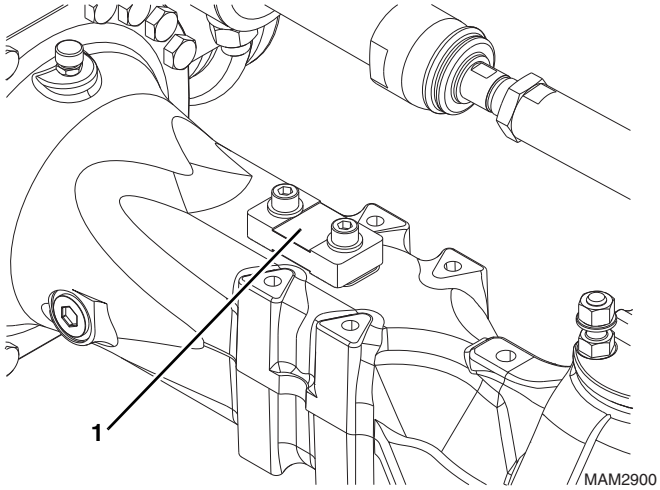
- The orange LED (**7**) illuminates when the following occurs:
  - The park brake is not applied and transmission control lever is in the forward or reverse position.
  - When approaching forward stability limitations, visual and audible indication is provided and the automatic function cut-out and/or slow down feature is disabled.
- Travel in accordance with the requirements set forth in Section 1 - General Safety Practices.
- When placing a load, ensure axles are not fully steered in either direction.

⚠ WARNING

TIP OVER HAZARD. If the green, orange and red LEDs flash and warning buzzer sounds, retract and lower boom immediately. Determine cause and correct before continued use.

- Test the LSI (**6**) at the beginning of each work shift.
  1. Fully retract and level the boom, with no load. Do not raise the boom during this test.
  2. Level frame using level in cab.
  3. Press the system check button on the LSI display. This will cause all LEDs to flash on and an audible warning to sound. This indicates that the system is functioning properly. If the test gives a different result, the system is not functioning properly and the machine must be removed from service and repaired before continued operation.

9.11.1 LSI Axle Sensor



The LSI axle sensor (**1**) is bolted on the top left of the rear axle.

Note: *If the rear axle is removed or replaced, the LSI Sensor must be installed AFTER the rear axle is installed and setting on all four wheels.*

a. LSI Axle Sensor Removal

1. Remove any fork carrier or attachment from the machine.
2. Park the machine on a firm, level surface, level the machine, fully retract the boom, fully raise the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
3. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
4. Open the battery and engine covers. Allow the engine to cool.
5. Properly disconnect the battery.
6. Disconnect the LSI electrical connector.
7. Loosen, remove and discard the two bolts holding the LSI assembly to the rear axle.
8. Remove and discard the sensor assembly.

b. LSI Axle Sensor Installation

1. Ensure threads of both bolt holes are clean and free from rust, water and debris.
2. Clean the bare metal with a degreasing agent, Loctite® 7063™.
3. Remove any excess degreasing agent and allow to dry.
4. Apply a thin film of Loctite® F246™ adhesive to the flat metal surface of the sensor, ensuring the adhesive is spread evenly over the entire surface.

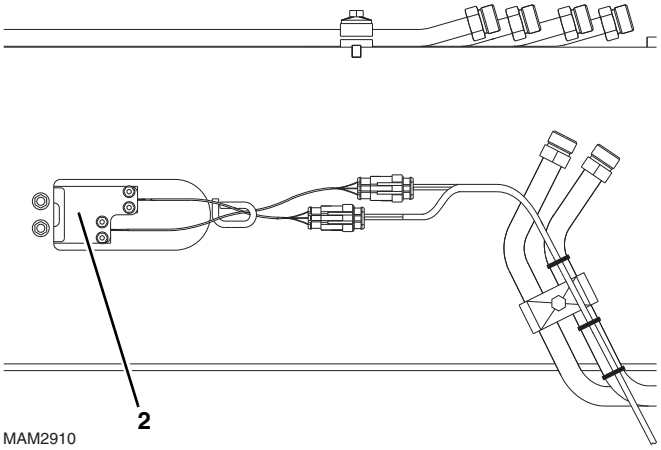
Note: *Follow all adhesive manufacturer's recommendations including storage life.*

5. Fit the sensor, ensuring the lead exits in the corner direction. Secure with two new bolts - Socket HD Capscrew M10x35x1.5, Grade 12.9.

Note: *It is important to prevent distortion of the sensor element, therefore tighten each bolt finger tight. Alternately tighten each bolt to 26 lb-ft (35 Nm) and finally to 52-59 lb-ft (70-80 Nm).*

6. Permanently mark position of bolt head and sensor body.
7. Leave the machine undisturbed for a minimum of 6 hours before moving.
8. Plug the electrical connector into the sensor assembly.
9. Properly connect the battery.
10. Close and secure the battery and engine covers.
11. Remove the Do Not Operate Tag from the ignition key switch and the steering wheel.
12. Calibrate the LSI system, refer to Section 9.11.4, "LSI System Calibration."

9.11.2 LSI Boom Sensors



The LSI sensors (**2**) are bolted on the left inside of the first boom section.

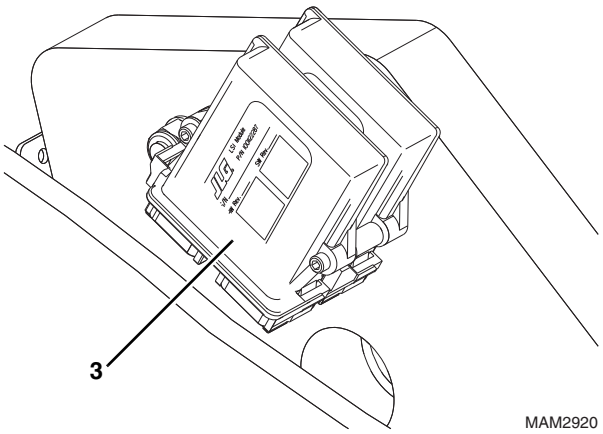
a. LSI Boom Sensor Removal

1. Remove any fork carrier or attachment from the machine.
2. Park the machine on a firm, level surface, level the machine, fully retract the boom, fully raise the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
3. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
4. Open the battery and engine covers. Allow the engine to cool.
5. Properly disconnect the battery.
6. Disconnect the LSI electrical connectors.
7. Loosen and remove the two bolts holding the LSI assembly to the side of the boom.
8. Remove and discard the sensor assembly.

b. LSI Sensor Boom Installation

1. Mount the LSI sensor to the side of the first boom section with the previously removed hardware. Do Not tighten the mounting bolts at this time.
2. Shim the LSI sensor within 2-3 mm (0.08-0.11in) of the second boom section. Tighten and torque the mounting bolts as required.
3. Plug the electrical connector into the sensor assembly.
4. Properly connect the battery.
5. Close and secure the battery and engine covers.
6. Remove the Do Not Operate Tags from both the ignition key and the steering wheel.

9.11.3 LSI Modules



The LSI modules (**3**) are bolted to the frame at the inside left rear corner.

a. LSI Module Removal

1. Remove any fork carrier or attachment from the machine.
2. Park the machine on a firm, level surface, level the machine, fully retract the boom, fully raise the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
3. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
4. Open the battery and engine covers. Allow the engine to cool.
5. Properly disconnect the battery.
6. Disconnect the LSI modules electrical connectors.
7. Loosen and remove the two bolts holding the LSI modules to the side of the frame.
8. Remove each module.

DO NOT disassemble the module(s). The module(s) are not serviceable. Replace module(s) if found to be defective.

b. LSI Module Installation

1. Mount the LSI modules to the side of the frame with the previously removed hardware. Tighten and torque the mounting bolts as required.
2. Plug the electrical connector into the module assemblies.
3. Properly connect the battery.
4. Close and secure the battery and engine covers.
5. Remove the Do Not Operate Tag from the ignition key switch and the steering wheel.

9.11.4 LSI System Calibration

a. Standard Calibration

To calibrate the LSI, certain conditions must be met:

- The sensors must be installed according to Section 9.11.1, “LSI Axle Sensor,” and Section 9.11.2, “LSI Boom Sensors.”
- The machine control system must be powered on for at least 10 minutes before calibration.
- The operator must remain in the cab.
- The calibration shall be conducted with the standard carriage and forks attached and weights as necessary (a range of 60 - 80% of maximum weight capacity).
- The machine must be on a level surface with the wheels steered straight and park brake off, with straight driving over a distance of at least 2 m (6.5 ft) being the last movement before entering a calibration point.
- While utilizing the LSI override button, 10 times lift and lower the boom stopping suddenly to induce the rear axle to bounce.
- Position the rear tires centrally on the scales.
- The calibration must be completed within 30 minutes after starting procedure.

Calibration Procedure:

1. Start and position the machine to perform the calibration procedure.
2. Remove the standard carriage and weight assembly.
3. Fully retract the boom and if equipped, lower the outriggers. Shut the machine OFF.
4. With ignition key in OFF position, press and hold SYSTEM CHECK button on LSI display and turn ignition key to engine START position. Release the ignition key when engine start is achieved, but continue to hold SYSTEM CHECK button on LSI display until the orange LED on LSI display goes out and buzzer sounds (approximately 3 seconds). Release SYSTEM CHECK button.
5. The LEDs will perform a rolling sequence. When only the third green LED illuminates, press the SYSTEM CHECK button.
6. The first green LED then illuminates. With no attachment, outriggers down (if equipped) and boom fully retracted, lift boom to maximum boom angle.
7. Press the SYSTEM CHECK button on the LSI display and release. The first 3 green LEDs will illuminate. The third then second green LEDs will go out as the calibration point is recorded.
8. The first green LED goes out and buzzer sounds then the red LED illuminates.
9. Lower boom until level. Pressing the LSI Override button may be required to lower the boom.
10. Attach the previously removed standard carriage, forks and weight.
11. Slowly extend the boom until the rear axle weight in the following table is achieved.

Model	Weight on Rear Axle
2505H & 25.5 CE	700 ± 20 lb (318 9 kg)
2505H & 25.5 AUS	1102 ± 29 lb (500 ± 9 kg)

12. Press the SYSTEM CHECK button on the LSI display and release. As the calibration point is recorded, buzzer sounds and the LEDs will flash and perform a sequence until all are flashing.
13. Perform the LSI- CAN Check PT to finalize the calibration. Refer to Section 9.11.5, “LSI-CAN Check PT.”

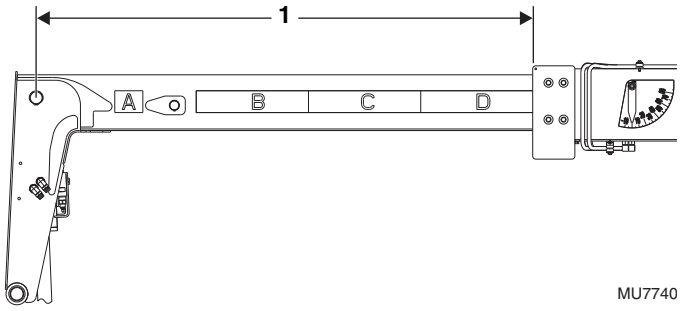
b. Field Calibration

To calibrate the LSI, certain conditions must be met:

- The sensor must be installed according to Section 9.11.1, “LSI Axle Sensor,” and Section 9.11.2, “LSI Boom Sensors.”
- The test weight matches the model being calibrated in the table shown on page 9-30.
- The calibration shall be conducted with standard carriage and forks attached to the machine.
- While utilizing the LSI override button, 10 times lift and lower the boom stopping suddenly to induce the rear axle to bounce.

Note: *If the test weight is not known, follow steps 1 & 2.*

Model	Market	Test Weight (W)	Xtip (1)	Xcal (2)
With Manual Quick Attach				
2505H & 25.5	CE & AUS	2000 kg (4408 lb)	1225 mm (48.25 in)	978 mm (38.5 in)
With Hydraulic Quick Attach				
2505H & 25.5	CE & AUS	2000 kg (4408 lb)	1200 mm (47.25 in)	952 mm (37.5 in)

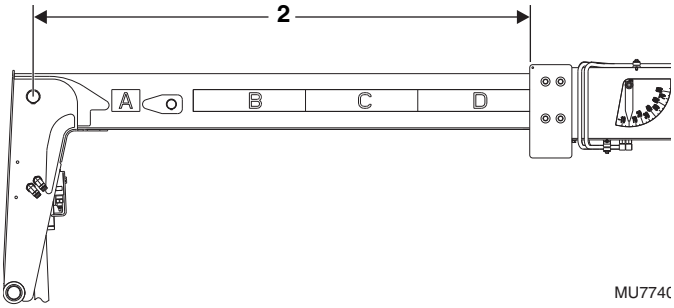


1. With the estimated test weight on the forks, start the machine and extend the boom horizontally until the machine starts to tip. This point should be at an extension of Xtip (**1**) of the second boom section. If the machine is not tipping at this extension, weight needs to be added or removed from the forks.
2. By confirming that the machine tips at this point, the correct amount of weight is now on the forks.
3. The machine control system must be powered on for at least 10 minutes before calibration.
4. The machine must be on a level surface with the wheels steered straight and park brake OFF. Drive the machine forward over a distance of at least 2 m (6.5 ft) before entering a calibration point.
5. Place test weight on ground, apply park brake and shut engine OFF. Do Not move machine.

Field Calibration Procedure:

Note: *The following procedure must be completed within 30 minutes of starting the procedure.*

1. With ignition key in OFF position, press and hold SYSTEM CHECK button on LSI display and turn ignition key to engine START position. Release the ignition key when engine start is achieved, but continue to hold SYSTEM CHECK button on LSI display until the orange LED on LSI display goes out and buzzer sounds (approximately 3 seconds). Release SYSTEM CHECK button.
2. The LEDs will perform a sequence. When only the third green LED illuminates, press the SYSTEM CHECK button.
3. The first green LED then illuminates. With no attachment and boom retracted, lift boom fully.
4. Press the SYSTEM CHECK button on the LSI display and release. The first 3 green LEDs will illuminate. The third then second green LEDs will go out as the calibration point is recorded.
5. The first green LED goes out and buzzer sounds then the red LED illuminates.
6. Lower boom and without moving the machine, pick up the proper test weight (**W**) listed in the table. Pressing the LSI Override button may be required to lower the boom.



7. With the boom horizontal, slowly extend the boom to the distance of Xcal (**2**). The proper calibration weight is now on the rear axle and the LSI can now be calibrated.

8. Press the SYSTEM CHECK button on the LSI display and release. As the calibration point is recorded, buzzer sounds and the LEDs will flash and perform a sequence until all are flashing.
9. Perform the LSI- CAN Check PT to finalize the calibration. Refer to Section 9.11.5, “LSI-CAN Check PT.”

Note: *The following procedure MUST BE performed to finalize the LSI System Calibration.*

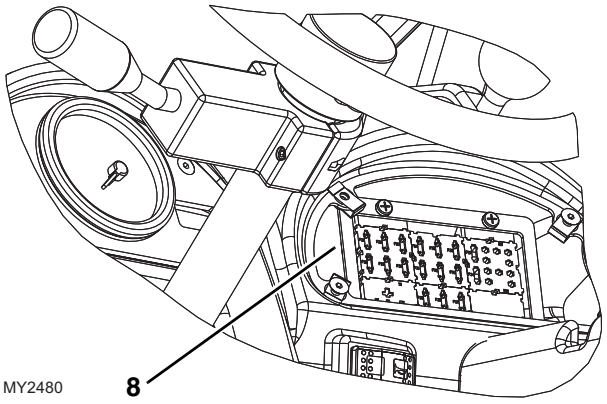
9.11.5 LSI-CAN Check PT

With the LSI calibrated, the UGM also needs calibrated and verified.

1. The machine must be on a level surface, wheels steered straight and park brake ON.
2. Connect the analyzer cable connector to the connector at the right rear corner of the cab by the operator seat.
3. Start the machine.
4. Press the “C” and “OK” buttons simultaneously on the analyzer.
5. Go to “ACCESS LEVEL 3” and press “OK”.
6. Enter the proper access code and press “OK”.
7. “ACCESS LEVEL 2” is now visible.
8. Go to “CALIBRATIONS” menu, press “OK”.
9. Scroll to “LSI_CAN CHECK PT”.
10. “SET LSI_CAN CHECK POINT”, use the arrow keys to change “NO” to “YES”.
11. Follow and execute the screen instructions:
    a. “Remove Weights and Attachments”, press “OK”.
    b. “TELESCOPE IN and FULLY LIFT UP”, press “OK”.
    c. “STOP, WAIT ONE MINUTE”, wait at least one minute and press “OK”.
    d. “PRESS ENTER TO SET CHECK POINT”, press “OK”
    e. Screen defaults back to “CALIBRATIONS: LSI_CAN CHECK POINT”.
    f. Press “C” for approximate two seconds to return to normal display screen.
    g. LSI Can Check is now complete.
12. Remove the analyzer.
13. Return machine to service.

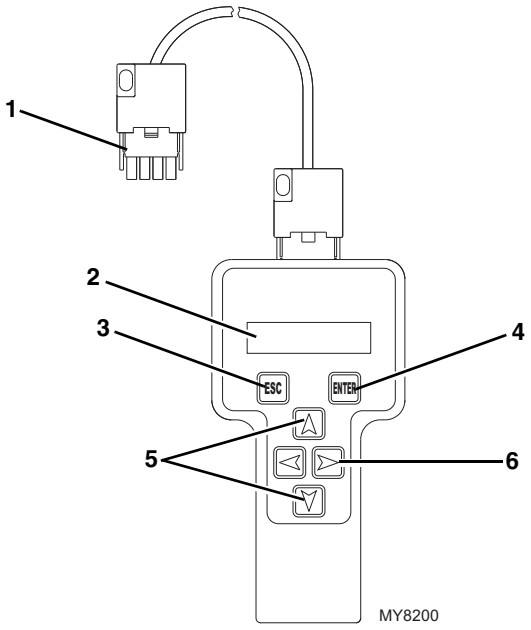
9.11.6 500 Hour - LSI UGM Calibration Check

1. The machine must be on a level surface, wheels steered straight and park brake ON.
2. Start machine.



3. Connect the analyzer cable connector to the connector behind the access panel on the right side of the dash (8).
4. Press the “C” and “OK” buttons simultaneously on the analyzer.
5. Go to “ACCESS LEVEL 3” and press “OK”.
6. Enter the proper access code and press “OK”.
7. “ACCESS LEVEL 2” is now visible.
8. Go to “OPERATOR TOOLS” menu, press “OK”.
9. Scroll to “LSI_CAN SYSTEM CHECK”.
10. “PERFORM LSI_CAN SYSTEM CHECK?”, use the arrow keys to change “NO” to “YES”.
11. Follow and execute the screen instructions:
    a. “Remove Weights and Attachments”, press “OK”.
    b. “TELESCOPE IN and FULLY LIFT UP”, press “OK”.
    c. “STOP, WAIT ONE MINUTE”, wait at least one minute and press “OK”.
    d. “PRESS ENTER TO START TEST”, press “OK”.
    e. Screen will show: “PRESS ENTER TO START TEST: PASS”.
    f. Must receive a “PASS”.
    g. Press “C” for approximate two seconds to return to normal display screen.
    h. LSI UGM Calibration Check is now complete.
12. Remove the analyzer.
13. Return machine to service.

9.12 HAND HELD ANALYZER (2505H & 25.5)



1. Cable Connector.
2. Analyzer Display Screen.
3. Escape Key: To return home or access previous menu.
4. Enter Key: Stores and selects Top Level, Sub Level and Items Menus.
5. Up/Down Arrow Keys: Change adjustable values.
6. Left and Right Arrow Keys: Used to move between Top Level, Sub Levels and Item Menus.

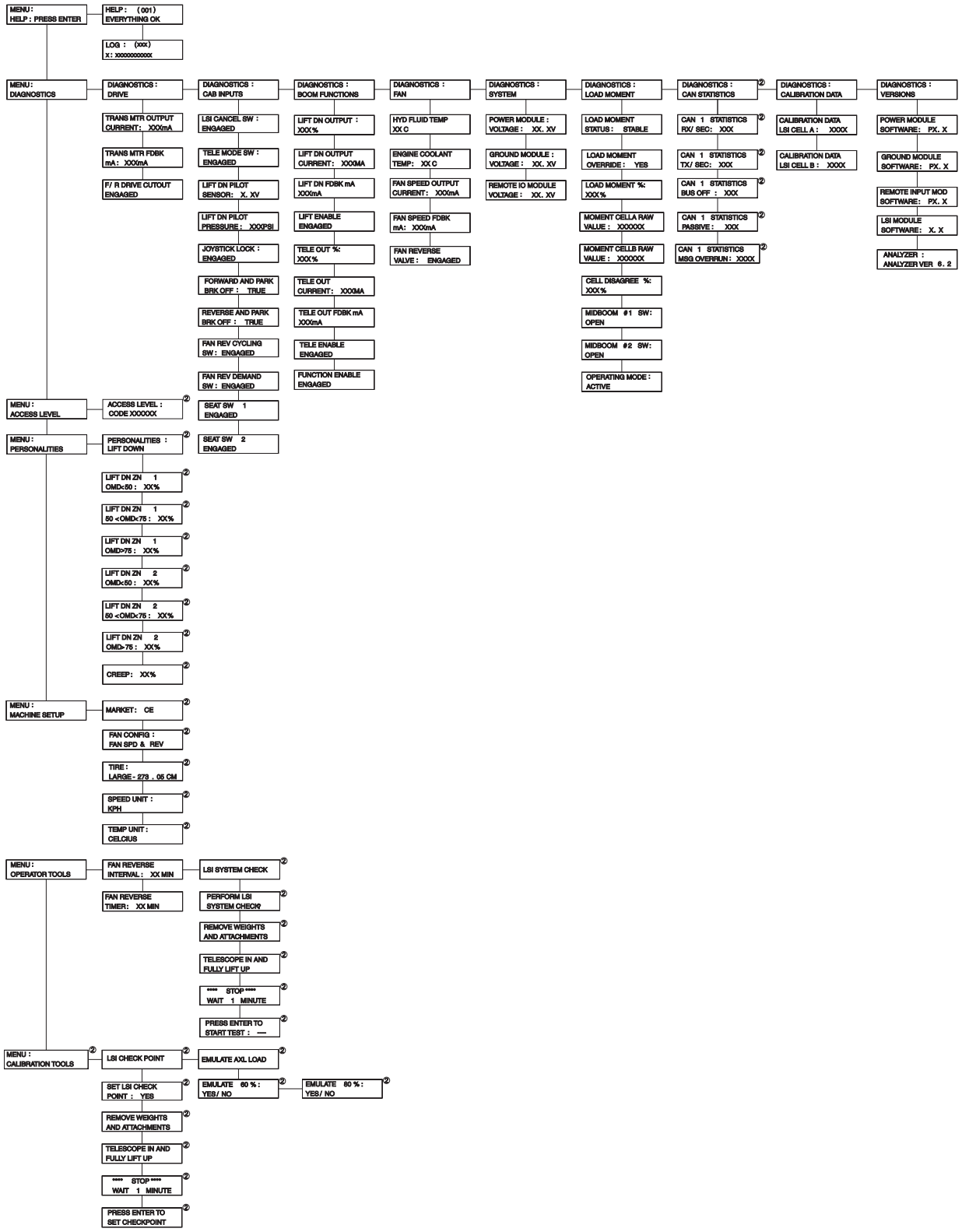
9.12.1 Analyzer Usage

Help messages can be viewed using the Analyzer (P/N 2901443). The Help messages can be accessed by pressing the ENTER key while viewing the current Help message. The Help message shall be EVERYTHING OK when no fault is present. The Analyzer cable plugs into the connector located behind the access panel on the right side of the dash.

For more information, contact the local **JLG** Dealer.

9.12.2 Analyzer Software - Version 1.0

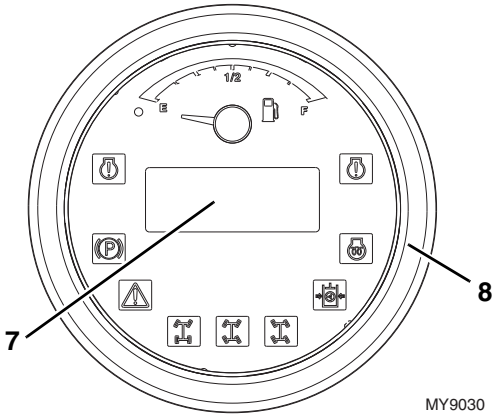
NOTE: **THE LAYOUT SHOWS ALL POSSIBLE ANALYZER SCREENS. PLEASE NOTE, SOME SCREENS MAY NOT BE AVAILABLE DEPENDING UPON MACHINE CONFIGURATION.**


MENU: HELP: PRESS ENTER
HELP: (001) EVERYTHING OK
LOG: (xxx) X: xxxxxxxxxx
MENU: DIAGNOSTICS
DIAGNOSTICS: DRIVE
TRANS MTR OUTPUT CURRENT: XXXmA
TRANS MTR FDBK mA: XXXmA
F/ R DRIVE CUTOUT ENGAGED
DIAGNOSTICS: CAB INPUTS
LSI CANCEL SW: ENGAGED
TELE MODE SW: ENGAGED
LIFT DN PILOT SENSOR: X. XV
LIFT DN PILOT PRESSURE: XXXPSI
JOYSTICK LOCK: ENGAGED
FORWARD AND PARK BRK OFF: TRUE
REVERSE AND PARK BRK OFF: TRUE
FAN REV CYCLING SW: ENGAGED
FAN REV DEMAND SW: ENGAGED
SEAT SW 1 ENGAGED
SEAT SW 2 ENGAGED
DIAGNOSTICS: BOOM FUNCTIONS
LIFT DN OUTPUT: XXX%
LIFT DN OUTPUT CURRENT: XXXmA
LIFT DN FDBK mA XXXmA
LIFT ENABLE ENGAGED
TELE OUT %: XXX%
TELE OUT CURRENT: XXXmA
TELE OUT FDBK mA XXXmA
TELE ENABLE ENGAGED
FUNCTION ENABLE ENGAGED
DIAGNOSTICS: FAN
HYD FLUID TEMP XX C
ENGINE COOLANT TEMP: XX C
FAN SPEED OUTPUT CURRENT: XXXmA
FAN SPEED FDBK mA: XXXmA
FAN REVERSE VALVE: ENGAGED
DIAGNOSTICS: SYSTEM
POWER MODULE: VOLTAGE: XX. XV
GROUND MODULE: VOLTAGE: XX. XV
REMOTE IO MODULE VOLTAGE: XX. XV
DIAGNOSTICS: LOAD MOMENT
LOAD MOMENT STATUS: STABLE
LOAD MOMENT OVERRIDE: YES
LOAD MOMENT %: XXX%
MOMENT CELLA RAW VALUE: XXXXXX
MOMENT CELLB RAW VALUE: XXXXXX
CELL DISAGREE %: XXX%
MIDBOOM #1 SW: OPEN
MIDBOOM #2 SW: OPEN
OPERATING MODE: ACTIVE
DIAGNOSTICS: CAN STATISTICS
CAN 1 STATISTICS RX/ SEC: XXX
CAN 1 STATISTICS TX/ SEC: XXX
CAN 1 STATISTICS BUS OFF: XXX
CAN 1 STATISTICS PASSIVE: XXX
CAN 1 STATISTICS MSG OVERRUN: XXXX
DIAGNOSTICS: CALIBRATION DATA
CALIBRATION DATA LSI CELL A: XXXX
CALIBRATION DATA LSI CELL B: XXXX
DIAGNOSTICS: VERSIONS
POWER MODULE SOFTWARE: PX. X
GROUND MODULE SOFTWARE: PX. X
REMOTE INPUT MOD SOFTWARE: PX. X
LSI MODULE SOFTWARE: X. X
ANALYZER: ANALYZER VER 6.2
MENU: ACCESS LEVEL
ACCESS LEVEL: CODE XXXXXX
MENU: PERSONALITIES
PERSONALITIES: LIFT DOWN
LIFT DN ZN 1 OMD<50: XX%
LIFT DN ZN 1 50 <OMD<75: XX%
LIFT DN ZN 1 OMD>75: XX%
LIFT DN ZN 2 OMD<50: XX%
LIFT DN ZN 2 50 <OMD<75: XX%
LIFT DN ZN 2 OMD>75: XX%
CREEP: XX%
MENU: MACHINE SETUP
MARKET: CE
FAN CONFIG: FAN SPD & REV
TIRE: LARGE - 273 . 05 CM
SPEED UNIT: KPH
TEMP UNIT: CELCIUS
MENU: OPERATOR TOOLS
FAN REVERSE INTERVAL: XX MIN
FAN REVERSE TIMER: XX MIN
LSI SYSTEM CHECK
PERFORM LSI SYSTEM CHECK?
REMOVE WEIGHTS AND ATTACHMENTS
TELESCOPE IN AND FULLY LIFT UP
**** STOP **** WAIT 1 MINUTE
PRESS ENTER TO START TEST: —
MENU: CALIBRATION TOOLS
LSI CHECK POINT
SET LSI CHECK POINT: YES
REMOVE WEIGHTS AND ATTACHMENTS
TELESCOPE IN AND FULLY LIFT UP
**** STOP **** WAIT 1 MINUTE
PRESS ENTER TO SET CHECKPOINT
EMULATE AXL LOAD
EMULATE 60 %: YES/ NO
EMULATE 60 %: YES/ NO

MY8840

9.13 DIAGNOSTIC TROUBLE CODES (DTC) ON GROUND MODULE

9.13.1 Gauge Fault Code Display



Fault codes will appear in the display area (7) of the gauge (8).

9.13.2 Fault Codes

Help Message	DTC	Trigger / Possible Symptom	Actions	Latch / Reset Condition
System OK	1	The Ground Module detects no problems exist	-	-
Power Cycle	211	Power was cycled on	-	-
Load Moment Shutoff Input - Invalid Signal	2336	LSI Cancel Switch depressed at Startup or for longer than 40seconds	Default machine to LSI Cutout (if not in passive mode and not in LSI calibration mode) and disregard LSI Cancel Switch Input override	Latched. Check wiring to Pin J1-3 on the Ground Module and integrity of mechanical switch
Lift Down Valve - Short to Battery	335	The module is detecting short to B+	Deactivate Lift Down Valve Output. Also deactivate Lift Enable if machine is in LSI Cutout	Latched. Check wiring to Pin J1-8 on the Ground Module
Lift Down Valve - Open Circuit	336	The module is detecting an open circuit	Deactivate Lift Down Output	Latched. Check wiring to Pin J1-8 on the Ground Module
Telescope Out Valve - Short to Battery	33123	The desired current is 0mA and the digital output driver's diagnostic feedback is low for a period of 250ms	Deactivate Telescope Out Output. Also deactivate Telescope Enable if machine is in LSI Cutout	Latched. Check wiring to Pin J1-9 on the Ground Module
Lift Enable Valve – Short to Ground	33159	The module is detecting a short to ground	Deactivate Lift Enable Output	Latched. Check wiring to Pin J1-7 on the Ground Module
Lift Enable Valve – Open Circuit	33160	The module is detecting an open circuit	Deactivate Lift Enable Output	Latched. Check wiring to Pin J1-7 on the Ground Module

Help Message	DTC	Trigger / Possible Symptom	Actions	Latch / Reset Condition
Lift Enable Valve - Short to Battery	33161	The module is detecting short to B+	Deactivate Lift Enable Output	Latched. Check wiring to Pin J1-7 on the Ground Module
Telescope Out Valve - Open Circuit	33186	The module is detecting an open circuit	Deactivate Telescope Out Output	Latched. Check wiring to Pin J1-9 on the Ground Module
Telescope Out Valve - Short to Ground	33188	The module is detecting a short to ground	Deactivate Telescope Out Output	Latched. Check wiring to Pin J1-9 on the Ground Module
Lift Down Valve - Short to Ground	33407	The module is detecting a short to ground	Deactivate Lift Down Output	Latched. Check wiring to Pin J1-8 on the Ground Module
Function Enable Output – Short to Battery	33438	The module is detecting short to B+	Deactivate Function Enable	Latched. Check wiring to Pin J1-11 on the Ground Module
Function Enable Output – Short to Ground	33443	The module is detecting a short to ground	Deactivate Function Enable	Latched. Check wiring to Pin J1-11 on the Ground Module
Telescope Enable Valve – Short to Ground	33444	The module is detecting a short to ground	Deactivate Telescope Enable Output	Latched. Check wiring to Pin J1-10 on the Ground Module
Telescope Enable Valve – Open Circuit	33439	The module is detecting an open circuit	Deactivate Telescope Enable Output	Latched. Check wiring to Pin J1-10 on the Ground Module
Telescope Enable Valve - Short to Battery	33440	The module is detecting short to B+	Deactivate Telescope Enable Output	Latched. Check wiring to Pin J1-10 on the Ground Module
Passive Mode Indicator – Short to Ground	33441	The module is detecting a short to ground	Deactivate Indicator Output	Latched. Check wiring to Pin J1-12 on the Ground Module
Passive Mode Indicator – Short to Battery	33442	This fault can only be detected if the machine is configured for the CE market. The module is detecting short to B+	Deactivate Indicator Output	Latched. Check wiring to Pin J1-12 on the Ground Module
Battery Voltage Low – System Shutdown	441	Battery voltage is less than 9V for at least 250ms and engine is not in a cranking state	Deactivate all Module Outputs	Not Latched Revert to normal operation when battery voltage greater than or equal to 11V for at least 1000mS
Battery Voltage Too High - System Shutdown	442	Battery voltage greater than 16V for at least 250mS	Deactivate all Module Outputs	Latched Fix supply voltage
Lift Valve – Pressure Sensor Voltage Out of Range	4578	The Ground module has detected that the pressure sensor voltage is less than 0.25V or greater than 4.75V	Limit all lift down speed to Creep mode without activating LSI Cutout	Latched. Check wiring to Pins J2-1, J2-2 on the Ground Module

Help Message	DTC	Trigger / Possible Symptom	Actions	Latch / Reset Condition
Conflicting Drive Direction Signals	462	This fault can only be present if the machine is configured for the CE market. Both passive mode inputs (fwd/park brake off AND rev/park brake off) are present concurrently	Default machine to Active Mode	Latched. Check wiring to Pins J1-5 on Ground Module and Pin J1-4 on Remote IO Module
CAN Bus Failure – LSI	6638	Ground Module lost CAN bus communication with LSI module and no messages have been received for a period of 1 second	Default machine to LSI Cutout if not in passive mode with operation only available via LSI Cancel switch (Creep Mode operation)	Not Latched Revert to normal operation when CAN bus communication is re-established
CAN Bus Failure - Remote Input Module	6642	Ground Module lost CAN bus communication with Remote Input Module and no messages have been received for a period of 250 ms	This fault can only occur if the machine detects itself to be a Tier 3 configuration: Default machine to LSI Cutout (if not in passive mode or not in LSI calibration mode) with operation only available via LSI Cancel switch (Creep Mode operation) This fault can only occur if the machine detects itself to be a Tier 4 configuration: Deactivate all Module Outputs	Not Latched Revert to normal operation when CAN bus communication is re-established
LSI Not Calibrated	8514	LSI CAN display indicates calibration is required	Permit LSI-CAN display to control its internal alarm	Not Latched. Once calibrated sequence performed, LSI display indicates completion
LSI Load Cell A - Out of Range	8516	LSI module detects condition and OMD reading is 100%	Machine automatically in LSI Cutout with operation only available via LSI Cancel Switch (Creep Mode operation) Permit LSI-CAN display to control its internal alarm	Latched. Check LSI gauge and sensor wiring
LSI Load Cell B - Out of Range	8517	LSI module detects condition and OMD reading is 100%	Machine automatically in LSI Cutout with operation only available via LSI Cancel Switch (Creep Mode operation) Permit LSI-CAN display to control its internal alarm	Latched. Check LSI gauge and sensor wiring

Help Message	DTC	Trigger / Possible Symptom	Actions	Latch / Reset Condition
LSI Cutout Output - Short to Battery or Open Circuit	8518	LSI module detects condition and OMD reading is 100%	Machine automatically in LSI Cutout with operation only available via LSI Cancel Switch (Creep Mode operation)	Latched. Check LSI gauge and sensor wiring
LSI Out of Calibration	8519	LSI has not been calibrated via CALIBRATION à LSI CAN CHECK PT or is not within tolerance during a OPERATOR TOOLS à LSI-CAN SYSTEM CHECK	Activate LSI Cutout if not in passive mode or not in LSI calibration mode Note: If fault is set due to LSI CAN CHECK PT not being completed, suppress LSI Cutout during the subsequent calibration procedure Permit LSI-CAN Display to control its internal alarm	Not Latched – fault clears if: LSI is calibrated or LSI CAN System Check is performed and passes
LSI Faulty - System Flash CRC Error	99152	The LSI System has detected a checksum error with its system flash and is reporting the issue on a CAN bus message to the Ground Module	Default machine to LSI Cutout (if not in passive mode or not in LSI calibration mode) with operation only available via LSI Cancel switch (Creep Mode operation)	Latched. Possibly replace LSI gauge
LSI Faulty - Data Flash CRC Error	99153	The LSI System has detected a checksum error with its system flash and is reporting the issue on a CAN bus message to the Ground Module	Default machine to LSI Cutout (if not in passive mode or not in LSI calibration mode) with operation only available via LSI Override switch (Creep Mode operation)	Latched. Possibly replace LSI gauge
LSI Faulty - Load Cells A and B Disagreement	99154	The LSI System has detected a unacceptable variance in the readings between Load Cell A and Load Cell B and is reporting the issue on a CAN bus message to the Ground Module	Default machine to LSI Cutout (if not in passive mode or not in LSI calibration mode) with operation only available via LSI Cancel switch (Creep Mode operation)	Latched. Possibly replace LSI gauge
Functions Locked Out – Remote Input Module Software Version Improper	99161	The Ground module has detected that Remote input module software is not compatible (Major version does not match)	Deactivate all Module Outputs	Latched. Check ground and remote module software versions

Help Message	DTC	Trigger / Possible Symptom	Actions	Latch / Reset Condition
Seat Switch Disagreement	23119	This fault can only occur if the machine detects itself to be a Tier 4 configuration. Disagreement between seat switch inputs is present for 5 seconds	N/A	Latched. Check wiring to Pins J2-7 on Ground and Remote IO modules
Ground Module Parameters not Received from Power Module	6643	This fault can only occur if the machine detects itself to be a Tier 4 configuration. startup delay of 1500ms has expired and has not received parameters from the Power Module	Default machine to LSI Cutout (if not in passive mode or not in LSI calibration mode) with operation only available via LSI Override switch (Creep Mode operation) This fault shall suppress DTC 9924 from being set	Not Latched

9.14 ENGINE DIAGNOSTIC TROUBLE CODE EMR4

9.14.1 Gauge Fault Code Display

Fault Codes	SPN Codes	FMI Codes	Deutz Description
1	132	11	Air flow sensor load correction factor exceeding the maximum drift limit; plausibility error
2	132	11	Air flow sensor load correction factor exceeding drift limit; plausibility error
3	132	11	Air flow sensor low idle correction factor exceeding the maximum drift limit
4	132	11	Air flow sensor load correction factor exceeding the maximum drift limit
9	172	2	Sensor ambient air temperature; plausibility error
34	523006	3	Controller mode switch; short circuit to battery
35	523006	4	Controller mode switch; short circuit to ground
36	523923	3	UB1; Short circuit to battery error of actuator relay 1
37	523924	3	UB2; Short circuit to battery error of actuator relay 2
38	523925	3	UB3; Short circuit to battery error of actuator relay 3
39	523926	3	UB4; Short circuit to battery error of actuator relay 4
40	523927	3	UB5; Short circuit to battery error of actuator relay 5
45	168	3	Sensor error battery voltage; signal range check high
46	168	4	Sensor error battery voltage; signal range check low
47	168	2	High battery voltage; warning threshold exceeded
48	168	2	Low battery voltage; warning threshold exceeded
49	597	2	Break lever main switch and break lever redundancy switch status not plausible
55	523910	14	Air pump doesn't achieve air mass flow set point
56	524013	7	Burner flame unintentional deleted
57	524020	14	Engine power; Not enough oxygen for regeneration
58	523911	0	Burner dosing valve (DV2); over current at the end of the injection phase
59	523911	12	Burner dosing valve (DV2); powerstage over temperature
60	523911	3	Burner dosing valve (DV2); short circuit to battery
61	523911	3	Burner dosing valve (DV2); short circuit to battery on high side
62	523911	4	Burner dosing valve (DV2); short circuit to ground
63	523911	11	Burner dosing valve (DV2); short circuit high side powerstage
64	523912	2	Burner dosing valve (DV2) downstream pressure sensor; plausibility error
66	523912	0	Physical range check high for burner dosing valve (DV2) downstream pressure; shut off regeneration
69	523912	1	Physical range check low for burner dosing valve (DV2) downstream pressure; shut off regeneration. When burner injector is actuated, the measured pressure does not rise above ca. 1250mbarabs (expected; ca. 2400mbar).
72	523912	3	Sensor error burner dosing valve (DV2) downstream pressure sensor; signal range check high
73	523912	4	Sensor error burner dosing valve (DV2) downstream pressure sensor; signal range check low
74	523913	3	Sensor error glow plug control diagnostic line voltage; signal range check high

Fault Codes	SPN Codes	FMI Codes	Deutz Description
75	523913	4	Sensor error glow plug control diagnostic line voltage; signal range check low
76	523914	5	Glow plug control; open load
77	523914	12	Glow plug control; powerstage over temperature
78	523914	3	Glow plug control; short circuit to battery
79	523914	4	Glow plug control; short circuit to ground
82	1235	14	CAN Bus error passive; warning CAN C
84	639	14	CAN-Bus 0 "BusOff-Status"
85	1231	14	CAN-Bus 1 "BusOff-Status"
86	1235	14	CAN-Bus 2 "BusOff-Status"
88	102	2	Charged air pressure above warning threshold
89	102	2	Charged air pressure above shut off threshold
96	110	3	Sensor error coolant temperature; signal range check high
97	110	4	Sensor error coolant temperature; signal range check low
98	110	0	High coolant temperature; warning threshold exceeded
99	110	0	High coolant temperature; shut off threshold exceeded
101	111	1	Coolant level too low
109	523929	0	Fuel Balance Control integrator injector 1 (in firing order); maximum value exceeded
110	523930	0	Fuel Balance Control integrator injector 2 (in firing order); maximum value exceeded
111	523931	0	Fuel Balance Control integrator injector 3 (in firing order); maximum value exceeded
112	523932	0	Fuel Balance Control integrator injector 4 (in firing order); maximum value exceeded
113	523933	0	Fuel Balance Control integrator injector 5 (in firing order); maximum value exceeded
114	523934	0	Fuel Balance Control integrator injector 6 (in firing order); maximum value exceeded
115	523929	1	Fuel Balance Control integrator injector 1 (in firing order); minimum value exceeded
116	523930	1	Fuel Balance Control integrator injector 2 (in firing order); minimum value exceeded
117	523931	1	Fuel Balance Control integrator injector 3 (in firing order); minimum value exceeded
118	523932	1	Fuel Balance Control integrator injector 4 (in firing order); minimum value exceeded
119	523933	1	Fuel Balance Control integrator injector 5 (in firing order); minimum value exceeded
120	523934	1	Fuel Balance Control integrator injector 6 (in firing order); minimum value exceeded
121	1109	2	Engine shut off demand ignored
122	523698	11	Shut off request from supervisory monitoring function
125	523717	12	Time out Error of CAN-Transmit-Frame AmbCon; Weather environments
126	523603	9	Time out Error of CAN-Receive-Frame AMB; Ambient Temperature Sensor

Fault Codes	SPN Codes	FMI Codes	Deutz Description
127	3224	2	DLC Error of CAN-Receive-Frame AT1IG1 NOX Sensor (SCR-system upstream cat; DPF-system downstream cat); length of frame incorrect
128	3224	9	Time out Error of CAN-Receive-Frame AT1IG1; NOX sensor upstream
129	3224	2	DLC Error of CAN-Receive-Frame ATIIGIVol NOX Sensor (SCR-system upstream cat; DPF-system downstream cat); length of frame incorrect
130	3224	9	Time out Error of CAN-Receive-Frame ATIIGIVol; NOX sensor (SCR-system upstream cat; DPF-system downstream cat)
133	523938	9	Time out Error (BAM to packet) for CAN-Receive-Frame ATIIGCVoll information; factors & Sensor calibration for NOX Sensor (SCR-system upstream cat; DPF-system downstream cat)
134	523939	9	Time out Error (BAM to BAM) for CAN-Receive-Frame ATIIGCVoll information; factors & Sensor calibration for NOX Sensor (SCR-system upstream cat; DPF-system downstream cat)
135	523940	9	Time out Error (PCK2PCK) for CAN-Receive-Frame ATIIGCVoll information; factors & Sensor calibration for NOX Sensor (SCR-system upstream cat; DPF-system downstream cat)
137	3234	9	Time out Error of CAN-Receive-Frame AT1OG1; NOX sensor (SCR-system downstream cat; DPF system downstream cat)
138	3234	2	DLC Error of CAN-Receive-Frame ATIOIVol NOX Sensor (SCR-system downstream cat; DPF-system downstream cat); length of frame incorrect
139	3234	9	Time out Error of CAN-Receive-Frame ATIOGIVol; NOX sensor (SCR-system downstream cat; DPF-system downstream cat)
140	523941	9	Time out Error (BAM to packet) for CAN-Receive-Frame ATIOGCVol2 information; factors & Sensor calibration for NOX Sensor (SCR-system downstream cat; DPF-system downstream cat)
141	523942	9	Time out Error (BAM to BAM) for CAN-Receive-Frame ATIOGCVol2 information; factors & Sensor calibration for NOX Sensor (SCR-system downstream cat; DPF-system downstream cat)
142	523943	9	Time out Error (PCK2PCK) for CAN-Receive-Frame ATIOGCVol2 information; factors & Sensor calibration for NOX Sensor (SCR-system downstream cat; DPF-system downstream cat)
168	523935	12	Time out Error of CAN-Transmit-Frame EEC3VOL1; Engine send messages
169	523936	12	Time out Error of CAN-Transmit-Frame EEC3VOL2; Engine send messages
171	523212	9	Time out Error of CAN-Receive-Frame ComEngPrt; Engine Protection
179	523240	9	Time out CAN-message FunModCtl; Function Mode Control
198	523216	9	Time out Error of CAN-Receive-Frame PrHtEnCmd; pre-heat command, engine command
202	523793	9	Time out Error of CAN-Receive-Frame UAA10; AGS sensor service message
203	523794	9	Time out Error of CAN-Receive-Frame UAA11; AGS sensor data
212	523803	9	Time out Error of CAN-Receive-Frame RxEngPres; Status burner air pump
281	523766	9	Time out Error of CAN-Receive-Frame Active TSC1AE
282	523767	9	Time out Error of CAN-Receive-Frame Passive TSC1AE
283	523768	9	Time out Error of CAN-Receive-Frame Active TSC1AR
284	523769	9	Time out Error of CAN-Receive-Frame Passive TSC1AR
285	523770	9	Time out Error of CAN-Receive-Frame Passive TSC1DE
291	523776	9	Time out Error of CAN-Receive-Frame TSC1TE - active

Fault Codes	SPN Codes	FMI Codes	Deutz Description
292	523777	9	Passive Time out Error of CAN-Receive-Frame TSC1TE; Set point
293	523778	9	Active Time out Error of CAN-Receive-Frame TSC1TR
294	523779	9	Passive Time out Error of CAN-Receive-Frame TSC1TR
299	523788	12	Time out Error of CAN-Transmit-Frame TrbCH; Status Wastegate
300	523605	9	Time out Error of CAN-Receive-Frame TSC1AE; Traction Control
301	523606	9	Time out Error of CAN-Receive-Frame TSC1AR; Retarder
305	898	9	Time out Error of CAN-Receive-Frame TSC1TE; Set point
306	520	9	Time out Error of CAN-Receive-Frame TSC1TR; Set point
322	523867	12	Time out Error of CAN-Transmit-Frame UAA1 on CAN 2; Burner Air Pump Control
360	523982	0	Powerstage diagnosis disabled; high battery voltage
361	523982	1	Powerstage diagnosis disabled; low battery voltage
376	630	12	Access error EEPROM memory (delete)
377	630	12	Access error EEPROM memory (read)
378	630	12	Access error EEPROM memory (write)
381	411	4	Physical range check low for EGR differential pressure
383	2791	5	Actuator EGR Valve; open load
384	2791	12	Actuator EGR Valve; powerstage over temperature
385	2791	3	Actuator EGR Valve; short circuit to battery
386	2791	4	Actuator EGR Valve; short circuit to ground
387	523612	12	Internal software error ECU; injection cut off
388	190	0	Overspeed detection in component engine protection
389	190	0	Engine speed above warning threshold (FOC-Level 1)
390	190	11	Engine speed above warning threshold (FOC-Level 2)
391	190	14	Engine speed above warning threshold (Overrun Mode)
412	108	3	Sensor error ambient air pressure; signal range check high
413	108	4	Sensor error ambient air pressure; signal range check low
417	171	3	Sensor error environment temperature; signal range check high
418	171	4	Sensor error environment temperature; signal range check low
419	190	8	Sensor camshaft speed; disturbed signal
420	190	12	Sensor camshaft speed; no signal
421	190	2	Offset angle between crank- and camshaft sensor is too large
422	190	8	Sensor crankshaft speed; disturbed signal
423	190	12	Sensor crankshaft speed; no signal
424	703	5	Engine running lamp; open load
425	703	12	Engine running lamp; powerstage over temperature
426	703	3	Engine running lamp; short circuit to battery
427	703	4	Engine running lamp; short circuit to ground
450	975	5	Digital fan control; open load
451	975	12	Digital fan control; powerstage over temperature
452	975	3	Digital fan control; short circuit to battery
453	975	4	Digital fan control; short circuit to ground
455	975	5	Fan actuator (PWM output); open load
456	975	12	Fan actuator (PWM output); powerstage over temperature

Fault Codes	SPN Codes	FMI Codes	Deutz Description
457	975	3	Fan actuator (PWM output); short circuit to battery
458	975	4	Fan actuator (PWM output); short circuit to ground
460	1639	0	Sensor error fan speed; signal range check high
461	1639	1	Sensor error fan speed; signal range check low
462	523602	0	High fan speed; warning threshold exceeded
463	523602	0	High fan speed; shut off threshold exceeded
464	97	3	Sensor error water in fuel; signal range check high
465	97	4	Sensor error water in fuel; signal range check low
472	94	3	Sensor error low fuel pressure; signal range check high
473	94	4	Sensor error low fuel pressure; signal range check low
474	94	1	Low fuel pressure; warning threshold exceeded
475	94	1	Low fuel pressure; shut off threshold exceeded
481	174	0	High low fuel temperature; warning threshold exceeded
482	174	0	High Low fuel temperature; shut off threshold exceeded
488	523619	2	Physical range check high for exhaust gas temperature up stream (SCR-CAT)
500	523915	0	HCI dosing valve (DV1); over current at the end of the injection phase
501	523915	12	HCI dosing valve (DV1); powerstage over temperature
502	523915	3	HCI dosing valve (DV1); short circuit to battery
503	523915	3	HCI dosing valve (DV1); short circuit to battery high side
504	523915	4	HCI dosing valve (DV1); short circuit to ground
505	523915	11	HCI dosing valve (DV1); short circuit high side powerstage
506	523916	2	Sensor HCI dosing valve (DV1) downstream pressure; plausibility error
508	523916	0	Physical range check high for HCI dosing valve (DV1) downstream pressure; shut off regeneration
511	523916	1	Physical range check low for HCI dosing valve (DV1) downstream pressure; shut off regeneration
514	523916	3	Sensor error HCI dosing valve (DV1) downstream pressure; signal range check high
515	523916	4	Sensor error HCI dosing valve (DV1) downstream pressure; signal range check low
516	523917	2	Sensor DV1 & DV2 upstream pressure; plausibility error
518	523917	0	Physical range check high for DV1 & DV2 upstream pressure; shut off regeneration
521	523917	1	Physical range check low for DV1 & DV2 upstream pressure; shut off regeneration
524	523917	3	Sensor error DV1 & DV2 upstream pressure; signal range check high
525	523917	4	Sensor error DV1 & DV2 upstream pressure; signal range check low
526	523918	2	Sensor DV1 & DV2 upstream temperature; plausibility error
528	523918	0	Physical range check high for DV1 & DV2 upstream temperature; shut off regeneration
531	523918	1	Physical range check low for DV1 & DV2 upstream temperature; shut off regeneration
534	523918	3	Sensor error DV1 & DV2 upstream temperature; signal range check high
535	523918	4	Sensor error DV1 & DV2 upstream temperature; signal range check low
543	676	11	Cold start aid relay error.
544	676	11	Cold start aid relay open load
545	729	5	Cold start aid relay open load

Fault Codes	SPN Codes	FMI Codes	Deutz Description
547	729	12	Cold start aid relay; over temperature error
559	523895	13	Check of missing injector adjustment value programming (IMA) injector 1 (in firing order)
560	523896	13	check of missing injector adjustment value programming (IMA) injector 2 (in firing order)
561	523897	13	check of missing injector adjustment value programming (IMA) injector 3 (in firing order)
562	523898	13	check of missing injector adjustment value programming (IMA) injector 4 (in firing order)
563	523899	13	check of missing injector adjustment value programming (IMA) injector 5 (in firing order)
564	523900	13	check of missing injector adjustment value programming (IMA) injector 6 (in firing order)
565	523350	4	Injector cylinder-bank 1; short circuit
566	523352	4	Injector cylinder-bank 2; short circuit
567	523354	12	Injector powerstage output defect
568	651	5	Injector 1 (in firing order); interruption of electric connection
569	652	5	Injector 2 (in firing order); interruption of electric connection
570	653	5	Injector 3 (in firing order); interruption of electric connection
571	654	5	Injector 4 (in firing order); interruption of electric connection
572	655	5	Injector 5 (in firing order); interruption of electric connection
573	656	5	Injector 6 (in firing order); interruption of electric connection
580	651	3	Injector 1 (in firing order); short circuit
581	652	3	Injector 2 (in firing order); short circuit
582	653	3	Injector 3 (in firing order); short circuit
583	654	3	Injector 4 (in firing order); short circuit
584	655	3	Injector 5 (in firing order); short circuit
585	656	3	Injector 6 (in firing order); short circuit
586	651	4	High side to low side short circuit in the injector 1 (in firing order)
587	652	4	High side to low side short circuit in the injector 2 (in firing order)
588	653	4	High side to low side short circuit in the injector 3 (in firing order)
589	654	4	High side to low side short circuit in the injector 4 (in firing order)
590	655	4	High side to low side short circuit in the injector 5 (in firing order)
591	656	4	High side to low side short circuit in the injector 6 (in firing order)
592	523615	5	Metering unit (Fuel-System); open load
593	523615	12	Metering unit (Fuel-System); powerstage over temperature
594	523615	3	Metering unit (Fuel-System); short circuit to battery high side
595	523615	4	Metering unit (Fuel-System); short circuit to ground high side
596	523615	3	Metering unit (Fuel-System); short circuit to battery low side
597	523615	4	Metering Unit (Fuel-System); short circuit to ground low side
604	1323	12	Too many recognized misfires in cylinder 1 (in firing order)
605	1324	12	Too many recognized misfires in cylinder 2 (in firing order)
606	1325	12	Too many recognized misfires in cylinder 3 (in firing order)
607	1326	12	Too many recognized misfires in cylinder 4 (in firing order)
608	1327	12	Too many recognized misfires in cylinder 5 (in firing order)

Fault Codes	SPN Codes	FMI Codes	Deutz Description
609	1328	12	Too many recognized misfires in cylinder 6 (in firing order)
610	1322	12	Too many recognized misfires in more than one cylinder
612	523612	12	Internal ECU monitoring detection reported error
613	523612	12	Internal ECU monitoring detection reported error
614	523612	12	Internal ECU monitoring detection reported error
615	523612	12	Internal ECU monitoring detection reported error
616	523612	12	Internal ECU monitoring detection reported error
617	523612	12	Internal ECU monitoring detection reported error
618	523612	12	Internal ECU monitoring detection reported error
619	523612	12	Internal ECU monitoring detection reported error
620	523612	12	Internal ECU monitoring detection reported error
621	523612	12	Internal ECU monitoring detection reported error
623	523612	12	Internal ECU monitoring detection reported error
624	523612	12	Internal ECU monitoring detection reported error
625	523612	12	Internal ECU monitoring detection reported error
627	523612	12	Internal ECU monitoring detection reported error
628	523612	12	Internal ECU monitoring detection reported error
637	523612	12	Internal ECU monitoring detection reported error
648	523008	1	Manipulation control was triggered
649	523008	2	Time out error in Manipulation control
732	100	3	Sensor error oil pressure; signal range check high
733	100	4	Sensor error oil pressure sensor; signal range check low
734	100	0	High oil pressure; system reaction initiated
735	100	0	High oil pressure; shut off threshold exceeded
736	100	1	Low oil pressure; warning threshold exceeded
737	100	1	Low oil pressure; shut off threshold exceeded
738	175	2	Sensor oil temperature; plausibility error
739	175	2	Sensor oil temperature; plausibility error oil temperature too high
740	175	0	Physical range check high for oil temperature
741	175	1	Physical range check low for oil temperature
743	175	3	Sensor error oil temperature; signal range check high
744	175	4	Sensor error oil temperature; signal range check low
745	175	0	High oil temperature; warning threshold exceeded
746	175	0	High oil temperature; shut off threshold exceeded
747	1237	2	Override switch; plausibility error
750	107	3	Sensor error air filter differential pressure; short circuit to battery
751	107	4	Sensor error air filter differential pressure; short circuit to ground
752	107	0	High air filter differential pressure; warning threshold exceeded
753	523919	2	Sensor air pump pressure; plausibility error
755	523919	0	Physical range check high for air pump pressure; shut off regeneration
758	523919	1	Physical range check low for air pump pressure; shut off regeneration
761	523919	3	Sensor error air pump pressure; signal range check high
762	523919	4	Sensor error air pump pressure; signal range check low
763	523920	2	Sensor exhaust gas back pressure; plausibility error

Fault Codes	SPN Codes	FMI Codes	Deutz Description
765	523920	0	Physical range check high for exhaust gas back pressure burner; shut off regeneration
768	523920	1	Physical range check low for exhaust gas back pressure burner; shut off regeneration
770	523920	3	Sensor error exhaust gas back pressure burner; signal range check high
771	523920	4	Sensor error exhaust gas back pressure burner; signal range check low
776	102	3	Sensor error charged air pressure; signal range check high
777	102	4	Sensor error charged air pressure; signal range check low
791	411	0	Physical range check high for differential pressure Venturi unit (EGR)
792	411	1	Physical range check low for differential pressure Venturi unit (EGR)
793	411	11	Sensor differential pressure Venturi unit (EGR); plausibility error
794	411	2	Sensor differential pressure Venturi unit (EGR); CAN signal invalid
795	411	3	Sensor error differential pressure Venturi unit (EGR); signal range check high
796	411	4	Sensor error differential pressure Venturi unit (EGR); signal range check low
805	524025	14	Particulate filter; regeneration not successful
807	3253	2	Sensor differential pressure (DPF); plausibility error regarding signal offset
809	3251	0	Physical range check high for differential pressure (DPF); shut off regeneration
812	3251	1	Physical range check low for differential pressure (DPF); shut off regeneration
814	3253	3	Sensor error differential pressure (DPF); signal range check high
815	3253	4	Sensor error differential pressure (DPF); signal range check low
825	523009	9	Pressure Relief Valve (PRV) reached maximum allowed opening count
826	523470	2	Pressure Relief Valve (PRV) forced to open; performed by pressure increase
827	523470	2	Pressure Relief Valve (PRV) forced to open; performed by pressure shock
828	523470	12	Open Pressure Relief Valve (PRV); shut off condition
829	523470	12	Open Pressure Relief Valve (PRV); warning condition
830	523470	14	Pressure Relief Valve (PRV) is open
831	523470	11	The PRV can not be opened at this operating point with a pressure shock
832	523470	11	Rail pressure out of tolerance range
833	523009	10	Pressure relief valve (PRV) reached maximum allowed open time
834	523906	5	Electrical fuel pre - supply pump; open load
835	523906	12	Electrical fuel pre - supply pump; power stage over temperature
836	523906	3	Electrical fuel pre - supply pump; short circuit to battery
837	523906	4	Electrical fuel pre - supply pump; short circuit to ground
838	523450	3	Multiple Stage Switch constant speed; short circuit to battery
839	523450	4	Multiple Stage Switch constant speed; short circuit to ground
840	523450	2	Multiple Stage Switch constant speed; plausibility error
841	523451	3	Multiple Stage Switch engine speed control parameter; short circuit to battery
842	523451	4	Multiple Stage Switch engine speed control parameter; short circuit to ground
843	523451	2	Multiple Stage Switch engine speed control parameter; plausibility error
844	523452	3	Multiple Stage Switch engine torque limitation curve; short circuit to battery
845	523452	4	Multiple Stage Switch engine torque limitation curve; short circuit to ground

Fault Codes	SPN Codes	FMI Codes	Deutz Description
846	523452	2	Multiple Stage Switch engine torque limitation curve; plausibility error
849	1176	3	Sensor error pressure sensor upstream turbine; signal range check high
850	1176	4	Sensor error pressure sensor downstream turbine; signal range check high
856	523613	0	Maximum positive deviation of rail pressure exceeded (RailMeUnO)
857	523613	0	Maximum positive deviation of rail pressure in metering unit exceeded (RailMeUnl)
858	523613	0	Rail system leakage detected (RailMeUnlO)
859	523613	0	Maximum negative deviation of rail pressure in metering unit exceeded (RailMeUn2)
860	523613	0	Negative deviation of rail pressure second stage (RailMeUn22)
861	523613	1	Minimum rail pressure exceeded (RailMeUn3)
862	523613	0	Maximum rail pressure exceeded (RailMeUn4)
864	523613	2	Set point of metering unit in overrun mode not plausible
876	523470	7	Maximum rail pressure in limp home mode exceeded (PRV)
877	157	3	Sensor error rail pressure; signal range check high
878	157	4	Sensor error rail pressure; signal range check low
881	523633	11	Nox conversion rate insufficient (SCR-Cat defect, bad AdBlue quality)
882	523633	11	Nox conversion rate insufficient (SCR-Cat defect, bad AdBlue quality); temperature range 1
883	523633	11	Nox conversion rate insufficient (SCR-Cat defect, bad AdBlue quality); temperature range 2
887	3234	11	Nox Sensor downstream of SCR Catalysator; plausibility error "stuck in range"
889	3224	1	Nox sensor upstream of SCR Catalysator; low signal not plausible
892	4345	11	Sensor back flow line pressure (SCR); plausibility error
893	4343	11	General pressure check error (SCR)
894	4374	13	Pressure stabilization error dosing valve (SCR)
896	523723	11	Detection of AdBlue filled SCR system in Init-State
897	523632	16	Pump pressure SCR metering unit too high
898	523632	18	Pump pressure SCR metering unit too low
899	523632	0	Pressure overload of SCR-System
900	523632	1	Pressure build-up error SCR-System
903	4365	0	Urea tank temperature too high
905	3241	0	Sensor SCR catalyst upstream temperature too high; plausibility error
906	3241	1	Sensor SCR catalyst upstream temperature too low; plausibility error
908	3361	7	AdBlue dosing valve blocked (SCR)
914	523720	2	Sensor urea supply module heater temperature; plausibility error (normal condition)
915	523720	2	Sensor urea supply module heater temperature; plausibility error (cold start condition)
916	523721	2	Sensor urea supply module temperature; plausibility error (normal condition)
917	523721	2	Sensor urea supply module temperature; plausibility error (cold start condition)
918	523981	11	Urea-tank without heating function (heating phase)
919	523330	14	Immobilizer status; fuel blocked
925	523720	8	Urea supply module heater temperature; duty cycle in failure range

Fault Codes	SPN Codes	FMI Codes	Deutz Description
926	523720	8	Urea supply module heater temperature; duty cycle in invalid range
927	523721	11	Urea supply module temperature measurement not available
928	523722	8	Urea supply module PWM signal; period outside valid range
929	523722	8	Detect faulty PWM signal from Supply Module
930	523721	8	Urea supply module temperature; duty cycle in failure range
931	523721	8	Urea supply module temperature; duty cycle in invalid range
932	29	3	Hand throttle idle validation switch; short circuit to battery
935	91	3	Sensor error accelerator pedal; signal range check high
936	29	3	Sensor error hand throttle; signal range check high
937	29	4	Hand throttle idle validation switch; short circuit to ground
940	91	4	Sensor error accelerator pedal; signal range check low
941	29	4	Sensor error hand throttle sensor; signal range check low
942	523921	3	Sensor error burner temperature; signal range check high
943	3532	3	Sensor error urea tank level; signal range check high
944	523921	4	Sensor error burner temperature; signal range check low
945	3532	4	Sensor error urea tank level; signal range check low
946	1079	13	Sensor supply voltage monitor 1 error (ECU)
947	1080	13	Sensor supply voltage monitor 2 error (ECU)
948	523601	13	Sensor supply voltage monitor 3 error (ECU)
956	677	3	Starter relay high side; short circuit to battery
957	677	4	Starter relay high side; short circuit to ground
958	677	5	Starter relay; no load error
959	677	12	Starter relay; power stage over temperature
960	677	3	Starter relay low side; short circuit to battery
961	677	4	Starter relay low side; short circuit to ground
963	523922	5	Burner shut off valve; open load
965	523922	3	Burner shut of valve; short circuit to battery
967	523922	4	Burner shut of valve; short circuit to ground
969	624	5	SVS lamp; open load
970	624	12	SVS lamp; power stage over temperature
971	624	3	SVS lamp; short circuit to battery
972	624	4	SVS lamp; short circuit to ground
973	523612	14	Software reset CPU SWReset 0
974	523612	14	Software reset CPU SWReset 1
975	523612	14	Software reset CPU SWReset 2
976	91	11	Plausibility error between APPl and APP2 or APPl and idle switch
980	523550	12	T50 start switch active for too long
981	172	3	Sensor error intake air; signal range check high
982	172	4	Sensor error intake air sensor; signal range check low
983	172	2	Intake air sensor; plausibility error
984	523921	11	Sensor burner temperature; plausibility error
986	523921	0	Physical range check high for burner temperature
989	523921	1	Physical range check low for burner temperature
994	105	3	Sensor error charged air temperature; signal range check high

Fault Codes	SPN Codes	FMI Codes	Deutz Description
995	105	4	Sensor error charged air temperature; signal range check low
996	105	0	High charged air cooler temperature; warning threshold exceeded
997	105	0	High charged air cooler temperature; shut off threshold exceeded
1007	412	3	Sensor error EGR cooler downstream temperature; signal range check high
1008	412	4	Sensor error EGR cooler downstream temperature; signal range check low
1009	412	2	Sensor exhaust gas temperature Venturi unit (EGR); plausibility error
1011	523960	0	Physical range check high for EGR cooler downstream temperature
1012	523960	1	Physical range check low for EGR cooler downstream temperature
1013	523960	11	Sensor exhaust gas temperature Venturi unit (EGR); plausibility error
1014	51	6	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); signal range check high
1015	51	5	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); signal range check low
1016	51	7	Actuator position for EGR-Valve (2.9,3.6) or Throttle-Valve (6.1,7.8) not plausible
1017	51	5	Actuator EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); open load
1018	51	12	Actuator EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); power stage over temperature
1019	51	3	EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); short circuit to battery
1020	51	4	EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); short circuit to ground
1021	51	12	Mechanical actuator defect EGR-Valve (2.9,3.6) or Throttle-Valve (6.1,7.8)
1022	51	6	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); signal range check high
1023	51	5	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); signal range check low
1024	51	3	Position sensor error of actuator EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); signal range check high
1025	51	4	Position sensor error actuator EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); signal range check low
1026	4769	2	Sensor exhaust gas temperature downstream (DOC); plausibility error
1029	4766	0	Physical range check high for exhaust gas temperature downstream (DOC)
1032	4766	1	Physical range check low for exhaust gas temperature downstream (DOC)
1034	4769	3	Sensor error exhaust gas temperature downstream (DOC); signal range check high
1035	4769	4	Sensor error exhaust gas temperature downstream (DOC); signal range check low
1036	4768	2	Sensor exhaust gas temperature upstream (DOC); plausibility error
1039	4765	0	Physical range check high for exhaust gas temperature upstream (DOC)
1042	4765	1	Physical range check low for exhaust gas temperature upstream (DOC]
1044	4768	3	Sensor error exhaust gas temperature upstream (DOC); signal range check high
1045	4768	4	Sensor error exhaust gas temperature upstream (DOC); signal range check low
1047	3248	4	Sensor error particle filter downstream temperature; signal range check low
1066	1180	11	Sensor exhaust gas temperature upstream turbine; plausibility error
1067	1180	3	Sensor error exhaust gas temperature upstream turbine; signal range check high

Fault Codes	SPN Codes	FMI Codes	Deutz Description
1068	1180	4	Sensor error exhaust gas temperature upstream turbine; signal range check low
1069	4360	0	Physical range check high for urea catalyst upstream temperature
1070	4360	1	Physical range low for urea catalyst upstream temperature
1072	4360	3	Sensor error urea catalyst exhaust gas temperature upstream; signal range check high
1073	4360	4	Sensor error urea catalyst exhaust gas temperature upstream; signal range check low
1074	1761	14	Urea tank level; warning threshold exceeded
1077	3361	3	Urea dosing valve; short circuit to battery on high side
1078	3361	3	Urea dosing valve; short circuit to battery or open load on high side
1079	3361	4	Urea dosing valve; short circuit to ground or open load on low side
1080	3361	4	Urea dosing valve; short circuit on high side
1081	4345	5	SCR heater relay urea return line secondary side; open load
1082	4366	5	SCR main relay (secondary side); open load
1083	4343	5	SCR heater relay urea pressure line secondary side; open load
1084	4366	5	SCR main relay (secondary side); Shortcut to battery
1085	4366	5	SCR main relay (secondary side); shortcut to ground
1086	4341	5	SCR heater relay urea supply line secondary side; open load
1087	523719	5	SCR heater relay urea supply module secondary side; open load
1088	4366	5	SCR Tank heating valve secondary side; open load
1089	4243	11	SCR system heater diagnostic reports error; shut off SCR-system
1090	4345	5	SCR heater relay urea return line primary side; open load
1092	4345	3	SCR heater urea return line; short circuit to battery
1093	4345	4	SCR heater urea return line; short circuit to ground
1094	4343	5	SCR heater relay urea pressure line primary side; open load
1096	4343	3	SCR heater urea pressure line; short circuit to battery
1097	4343	4	SCR heater urea pressure line; short circuit to ground
1098	523718	5	SCR main relay (primary side); open load
1099	523718	12	SCR main relay (primary side); powerstage over temperature
1100	523718	3	SCR main relay (primary side); short circuit to battery
1101	523718	4	SCR main relay (primary side); short circuit to ground
1102	4341	5	SCR heater relay urea supply line primary side; open load
1104	4341	3	SCR-heater urea supply line; short circuit to battery
1105	4341	4	SCR-heater urea supply line; short circuit to ground
1106	523719	5	SCR heater relay urea supply module primary side; open load
1108	523719	3	SCR heater urea supply module; short circuit to battery
1109	523719	4	SCR heater urea supply module; short circuit to ground
1110	4366	5	SCR tank heating valve primary side; open load
1111	4366	12	SCR-heater relay urea tank powerstage output; over temperature
1112	4366	3	SCR Tank heating valve; short circuit to battery
1113	4366	4	SCR Tank heating valve; short circuit to ground
1118	4375	5	Urea pump motor; open load
1120	4375	3	Urea pump motor; short circuit to battery

Fault Codes	SPN Codes	FMI Codes	Deutz Description
1121	4375	4	Urea pump motor; short circuit to ground
1122	4334	0	Physical range check high for Urea Pump Pressure
1123	4334	1	Physical range check low for Urea Pump Pressure
1124	4334	0	Urea pump pressure sensor; high signal not plausible
1125	4334	1	Urea pump pressure sensor; low signal not plausible
1127	4334	3	Sensor error urea pump pressure; signal range check high
1128	4334	4	Sensor error urea pump pressure; signal range check low
1129	4376	5	SCR reversing valve; open load
1130	4376	12	SCR reversing valve; over temperature
1131	4376	3	SCR reversing valve; short circuit to battery
1132	4376	4	SCR reversing valve; short circuit to ground
1135	3031	0	AdBlue-Tank temperature; maximum exceeded
1136	3031	1	DEF-Tank temperature; below minimum
1138	3031	3	Sensor error urea tank temperature; short circuit to battery
1139	3031	4	Sensor error urea tank temperature; short circuit to ground
1157	97	12	Water in fuel level prefilter; maximum value exceeded
1158	523946	0	Zero fuel calibration injector 1 (in firing order); maximum value exceeded
1159	523947	0	Zero fuel calibration injector 2 (in firing order); maximum value exceeded
1160	523948	0	Zero fuel calibration injector 3 (in firing order); maximum value exceeded
1161	523949	0	Zero fuel calibration injector 4 (in firing order); maximum value exceeded
1162	523950	0	Zero fuel calibration injector 5 (in firing order); maximum value exceeded
1163	523951	0	Zero fuel calibration injector 6 (in firing order); maximum value exceeded
1164	523946	1	Zero fuel calibration injector 1 (in firing order); minimum value exceeded
1165	523947	1	Zero fuel calibration injector 2 (in firing order); minimum value exceeded
1166	523948	1	Zero fuel calibration injector 3 (in firing order); minimum value exceeded
1167	523949	1	Zero fuel calibration injector 4 (in firing order); minimum value exceeded
1168	523950	1	Zero fuel calibration injector 5 (in firing order); minimum value exceeded
1169	523951	1	Zero fuel calibration injector 6 (in firing order); minimum value exceeded
1170	523612	12	Internal software error ECU
1171	175	2	Customer oil temperature; signal un-plausible
1173	523973	14	SCR Tamper detection; derating timer below limit 1
1174	523974	14	SCR Tamper detection; derating timer below limit 2
1175	523975	14	Urea quality; derating timer below limit 1
1176	523976	14	Urea quality; derating timer below limit 2
1177	523977	14	Urea tank level; derating timer below limit 1
1178	523978	14	Urea tank level; derating timer below limit 2
1180	168	0	Physical range check high for battery voltage
1181	168	1	Physical range check low for battery voltage
1182	172	0	Physical range check high for intake air temperature
1183	172	1	Physical range check low for intake air temperature
1187	523980	14	Bad quality of reduction agent detected
1192	523922	12	Over temperature error on burner shut of valve
1193	1180	0	Physical range check high for exhaust gas temperature upstream turbine
1194	1180	1	Physical range check low for exhaust gas temperature upstream turbine

Fault Codes	SPN Codes	FMI Codes	Deutz Description
1216	523914	5	Glow plug control release line; short circuit error
1217	523914	11	Glow plug control; internal error
1219	524018	14	DPF wasn't regenerated, power reduction phase 1 (manual regeneration request)
1220	524022	14	DPF wasn't regenerated, power reduction phase 2 (manual regeneration request)
1221	524023	14	DPF wasn't regenerated, warning condition (manual regeneration mode)
1222	190	14	Camshaft- and Crankshaft speed sensor signal not available on CAN
1223	51	5	Actuator EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); open load
1224	51	6	Actuator EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); over current
1225	51	12	Actuator EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); over temperature
1226	51	3	EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); short circuit to battery (A02)
1227	51	3	EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); short circuit to battery (A67)
1228	51	4	EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); short circuit to ground (A02)
1229	51	4	EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); short circuit to ground (A67)
1230	51	6	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); Overload by short-circuit
1231	51	11	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); Power stage over temperature due to high current
1232	51	4	Actuator error EGR-Valve (2.9;3.6) or Throttle-Valve (6.1,7.8); Voltage below threshold
1239	523984	3	UB6; Short circuit to battery error of actuator relay 7
1240	523985	3	UB7; Short circuit to battery error of actuator relay £
1243	523988	5	Charging lamp; open load
1244	523988	12	Charging lamp; over temperature
1245	523988	3	Charging lamp; short circuit to battery
1246	523988	4	Charging lamp; short circuit to ground
1247	524019	11	Air Pump; air lines blocked
1248	523910	9	Air Pump; CAN communication lost
1249	523910	7	Air pump; CAN communication interrupted no purge function available
1250	523910	12	Air Pump; internal error
1251	523910	0	Air Pump; power stage over temperature
1252	523910	0	Air Pump; operating voltage error
1253	523911	7	Burner dosing valve (DV2); blocked closed
1254	524014	1	Air pressure glow plug flush line; below limit
1255	524013	7	Burner operation is interrupted too often
1256	523915	7	HCI dosing valve (DV1); blocked closed
1257	523915	7	HCI dosing valve (DV1); blocked open
1258	524016	11	HFM sensor; electrical fault
1259	524016	2	Amount of air is not plausible to pump speed
1260	524016	2	Calculated amount of air is not plausible to HFM reading
1261	523910	6	Air Pump; over current
1262	523922	7	Burner Shut Off Valve; blocked closed
1263	524021	11	Burner fuel line pipe leak behind Shut Off Valve
1264	523922	7	Burner Shut Off Valve; blocked open

Fault Codes	SPN Codes	FMI Codes	Deutz Description
1265	524017	12	Spark plug control unit (SPCU); electrical fault
1266	524017	12	Spark plug control unit (SPCU); internal error
1267	523989	0	Fuel Balance Control integrator injector 7 (in firing order); maximum value exceeded
1268	523990	0	Fuel Balance Control integrator injector 8 (in firing order); maximum value exceeded
1269	523989	1	Fuel Balance Control integrator injector 7 (in firing order); minimum value exceeded
1270	523990	1	Fuel Balance Control integrator injector 8 (in firing order); minimum value exceeded
1279	523992	9	Time out Error of CAN-Receive-Frame DM19Voll; NOX sensor upstream
1283	523993	9	Time out Error of CAN-Receive-Frame DM19Vol2; NOX sensor downstream
1285	524038	9	Time out error of CAN-Receive-Frame ComMS_SyslTO (error memory Slave); Master-Slave internal CAN message
1286	524039	9	Time out error of CAN-Receive-Frame ComMS_Sys2TO (error memory Slave); Master-Slave internal CAN message
1287	524040	9	Time out error of CAN-Receive-Frame ComMS_Sys3TO (error memory Slave); Master-Slave internal CAN message
1288	524041	9	Time out error of CAN-Receive-Frame ComMS_Sys4TO (error memory Slave); Master-Slave internal CAN message
1289	524042	9	Time out error of CAN-Receive-Frame ComMS_Sys5TO (error memory Slave); Master-Slave internal CAN message
1290	524043	9	Time out error of CAN-Receive-Frame ComMS_Sys6TO (error memory Slave); Master-Slave internal CAN message
1291	524045	9	Master-Slave CAN; Message-Counter-Error of CAN-Receive-Frame ComMSMoFOvR
1292	524046	9	Master-Slave CAN; Checksum-Error of CAN-Receive-Frame ComMSMoFOvR
1293	524047	9	Master-Slave CAN; Messsage-Length-Error of CAN-Receive-Frame ComMSMoFOvR
1294	524048	9	Time out error CAN message ComMSMoFOvRlTO error memory Slave
1295	524049	9	Message copy error in the Master/ Slave data transfer
1297	523788	0	CAN-Transmit-Frame ComTrbChActr "BusOff-Satus"; Wastegate
1298	523788	0	CAN-Transmit-Frame ComTrbChActr disable error; wastegate
1299	523788	0	CAN-Transmit-Frame ComTrbChActr plausibility error; wastegate
1300	523788	0	Time out Error of CAN-Transmit-Frame ComTrbChActr; Wastegate
1302	524024	11	Deviation of the exhaust gas temperature set point to actual value downstream (DOC) too high
1324	523995	13	check of missing injector adjustment value programming (IMA) injector 7 (in firing order)
1325	523996	13	check of missing injector adjustment value programming (IMA) injector 8 (in firing order)
1327	523998	4	Injector cylinder bank 2 slave; short circuit
1328	523999	12	Injector powerstage output Slave defect
1329	524000	5	Injector 7 (in firing order); interruption of electric connection
1330	524001	5	Injector 8 (in firing order); interruption of electric connection
1333	524000	3	Injector 7 (in firing order); short circuit

Fault Codes	SPN Codes	FMI Codes	Deutz Description
1334	524001	3	Injector 8 (in firing order); short circuit
1335	524000	4	High side to low side short circuit in the injector 7 (in firing order)
1336	524001	4	High side to low side short circuit in the injector 8 (in firing order)
1337	2797	4	Injector diagnostics; time out error of short circuit to ground measurement cyl. Bank 0
1338	2798	4	Injector diagnostics; time out error of short circuit to ground measurement cyl. Bank 1
1339	2798	4	Injector diagnostics; short circuit to ground monitoring Test in Cyl. Bank 0
1340	2798	4	Injector diagnostics; short circuit to ground monitoring Test in Cyl. Bank 1
1341	524035	12	Injector diagnostics; time out error in the SPI communication
1342	524036	12	Injector diagnostics Slave; time out error in the SPI communication
1343	524004	12	Too many recognized misfires in cylinder 7 (in firing order)
1344	524005	12	Too many recognized misfires in cylinder 8 (in firing order)
1345	524069	9	Time out Error of CAN-Receive-Frame MSMon_FidFCCTO; Master-Slave CAN communication faulty
1357	524052	11	Error memory Slave reports FID MSMonFC2; Shut-Off Path test error of fuel injection system
1368	524052	11	Error memory Slave reports FID MSMonFC3; time out of engine state messages (ComMS_Sysl-7) from master ECU
1378	523919	2	Sensor air pump airpressure; plausibility error
1379	523920	2	Sensor exhaust gas back pressure burner; plausibility error
1380	3253	2	Sensor differential pressure (DPF); plausibility error
1381	164	2	Rail pressure safety function is not executed correctly
1389	523922	5	Burner Shut Off Valve; open load
1390	523922	12	Burner Shut Off Valve; powerstage over temperature
1392	523922	4	Burner Shut Off Valve; short circuit to ground
1395	523921	2	Sensor burner temperature; plausibility error
1398	1136	0	Physical range check high for ECU temperature
1399	1136	1	Physical range check low for ECU temperature
1400	1136	3	Sensor error ECU temperature; signal range check high
1401	1136	4	Sensor error ECU temperature; signal range check low
1402	4769	2	Sensor exhaust gas temperature OxiCat downstream (normal operation); plausibility error
1403	4769	2	Sensor exhaust gas temperature OxiCat downstream (regeneration); plausibility error
1404	3248	2	Sensor exhaust gas temperature downstream DPF; plausibility error
1405	3248	0	Physical range check high for exhaust gas temperature particulate filter downstream
1406	3248	0	Physical range check high for exhaust gas temperature particulate filter downstream; shut off regeneration
1407	3248	0	Physical range check high for exhaust gas temperature particulate filter downstream; warning
1408	3248	1	Physical range check low for exhaust gas temperature particulate filter downstream
1409	3248	1	Physical range check low for exhaust gas temperature particulate filter downstream; shut off regeneration

Fault Codes	SPN Codes	FMI Codes	Deutz Description
1410	3248	1	Physical range check low for exhaust gas temperature particulate filter downstream; warning
1411	1188	11	Wastegate actuator; internal error
1412	1188	11	Wastegate actuator; EOL calibration not performed correctly
1413	1188	13	Wastegate actuator calibration deviation too large, re-calibration required
1414	1188	2	Wastegate; status message from ECU missing
1415	1188	7	Wastegate actuator; blocked
1416	1188	11	Wastegate actuator; over temperature (> 145°C]
1417	1188	11	Wastegate actuator; over temperature (> 135°C]
1418	1188	11	Wastegate actuator; operating voltage error
1419	524011	0	Zero fuel calibration injector 7 (in firing order); maximum value exceeded
1420	524012	0	Zero fuel calibration injector 8 (in firing order); maximum value exceeded
1421	524011	1	Zero fuel calibration injector 7 (in firing order); minimum value exceeded
1422	524012	1	Zero fuel calibration injector 8 (in firing order); minimum value exceeded
1431	524028	2	CAN message PROEGRActr; plausibility error
1432	524029	2	Time out Error of CAN-Receive-Frame ComEGRActr - exhaust gas recirculation positioner
1436	524034	5	Disc Separator; open load
1437	524034	12	Disc Separator; power stage over temperature
1438	524034	3	Disc separator; short circuit to battery
1439	524034	4	Disc separator; short circuit to ground
1440	524030	7	EGR actuator; internal error
1441	524031	13	EGR actuator; calibration error
1442	524032	2	EGR actuator; status message "EGRCust" is missing
1443	524033	7	EGR actuator; due to overload in Save Mode
1444	2621	5	Flush valve burner (EPV DPF-System); open load
1445	2621	12	Flush valve burner (EPV DPF-System); powerstage over temperature
1446	2621	3	Flush valve burner (EPV DPF-System); short circuit to battery
1447	2621	4	Flush valve burner (EPV DPF-System); short circuit to ground
1448	175	0	High customer oil temperature; warning threshold exceeded
1449	175	0	High customer oil temperature; shut off threshold exceeded
1453	411	0	Differential pressure Venturi unit (EGR); warning threshold exceeded
1454	411	1	Differential pressure Venturi unit (EGR); shut off threshold exceeded
1455	3711	12	Regeneration temperature (PFltRgn LigtOff) not reached; regeneration aborted
1457	524055	4	Spark Plug Control Unit (SPCU); short circuit to ground
1458	523960	0	High exhaust gas temperature EGR cooler downstream; warning threshold exceeded
1459	523960	1	High exhaust gas temperature EGR cooler downstream; shut off threshold exceeded
1460	1180	0	Turbocharger Wastegate CAN feedback; warning threshold exceeded
1460	1180	0	Turbocharger Wastegate CAN feedback; warning threshold exceeded
1461	1180	1	Turbocharger Wastegate CAN feedback; shut off threshold exceeded
1461	1180	1	Turbocharger Wastegate CAN feedback; shut off threshold exceeded
1462	1180	0	Exhaust gas temperature upstream turbine; warning threshold exceeded

Fault Codes	SPN Codes	FMI Codes	Deutz Description
1462	1180	0	Exhaust gas temperature upstream turbine; warning threshold exceeded
1463	1180	1	Exhaust gas temperature upstream turbine; shut off threshold exceeded
1463	1180	1	Exhaust gas temperature upstream turbine; shut off threshold exceeded
1474	524037	5	Ash lamp; open load
1474	524037	5	Ash lamp; open load
1475	34	2	Sensor vehicle speed; plausibility error
1475	84	2	Sensor vehicle speed; plausibility error
1477	524037	3	Ash lamp; short circuit to battery
1477	524037	3	Ash lamp; short circuit to battery
1478	524037	4	Ash lamp; short circuit to ground
1478	524037	4	Ash lamp; short circuit to ground
1479	524062	12	Regeneration inhibit switch not available; ComInhSwtNA
1479	524062	12	Regeneration inhibit switch not available; ComInhSwtNA
1480	524062	12	Regeneration release switch not available; ComRegSwtNA
1480	524062	12	Regeneration release switch not available; ComRegSwtNA
1481	524025	5	DPF system; operating voltage error
1482	524044	9	CAN message ComMS_Sys7 not received from slave
1483	523632	2	Metering control is not performed in time error
1484	524068	2	Master ECU and Slave ECU have been identified as the same types
1484	524068	2	Master ECU and Slave ECU have been identified as the same types
1485	524052	11	Master ECU and Slave ECU data sets or software are not identical
1485	524052	11	Master ECU and Slave ECU data sets or software are not identical
1486	523718	5	SCR main relay; open load (only CV56B)
1487	523718	12	SCR main relay; powerstage over temperature (only CV56B)
1487	523718	12	SCR main relay; powerstage over temperature (only CV56B)
1488	523718	3	SCR main relay; short circuit to battery (only CV56B)
1488	523718	3	SCR main relay; short circuit to battery (only CV56B)
1489	523718	4	SCR main relay; short circuit to ground (onlyCV56B)
1489	523718	4	SCR main relay; short circuit to ground (only CV56B)
1490	4376	5	SCR reversing valve; open load
1490	4376	5	SCR reversing valve; open load
1491	4376	12	SCR reversing valve; over temperature
1491	4376	12	SCR reversing valve; over temperature
1493	4376	4	SCR reversing valve; short circuit to ground
1493	4376	4	SCR reversing valve; short circuit to ground
1494	2659	0	Physical range check high for EGR mass flow
1494	2659	0	Physical range check high for EGR mass flow
1495	2659	1	Physical range check low for EGR mass flow
1495	2659	1	Physical range check ow for EGR mass flow
1496	2659	11	Exhaust gas recirculation; EGR mass flow; shut off demand
1496	2659	11	Exhaust gas recirculation; EGR mass flow; shut off demand
1505	524057	2	Electric fuel pump; fuel pressure build up error
1505	524057	2	Electric fuel pump; fuel pressure build up error
1523	2659	2	Exhaust gas recirculation AGS sensor; plausibility error

Fault Codes	SPN Codes	FMI Codes	Deutz Description
1523	2659	2	Exhaust gas recirculation AGS sensor; plausibility error
1524	2659	0	Physical range check high for EGR exhaust gas mass flow
1524	2659	0	Physical range check high for EGR exhaust gas mass flow
1525	2659	1	Physical range check low for EGR exhaust gas mass flow
1525	2659	1	Physical range check low for EGR exhaust gas mass flow
1526	2659	12	Exhaust gas recirculation; AGS sensor has "burn off" not performed
1526	2659	12	Exhaust gas recirculation; AGS sensor has "burn off[1]' not performed
1527	2659	2	AGS sensor temperature exhaust gas mass flow; plausibility error
1527	2659	2	AGS sensor temperature exhaust gas mass flow; plausibility error
1615	3699	14	Maximum stand-still-duration reached; oil exchange required
1615	3699	14	Maximum stand-still-duration reached; oil exchange required
1616	3699	2	DPF differential pressure sensor and a further sensor or actuator CRT system defective
1616	3699	2	DPF differential pressure sensor and a further sensor or actuator CRT system defective
1617	3699	2	Temperature sensor us. and ds. DOC simultaneously defect
1617	3699	2	Temperature sensor us, and ds, DOC simultaneously defect
1659	524114	9	Time out error of CAN-Transmit-Frame A1DOC
1659	524114	9	Time out error of CAN-Transmit-Frame A1DOC
1660	524115	9	Time out error of CAN-Transmit-Frame AT1S
1660	524115	9	Time out error of CAN-Transmit-Frame AT IS
1661	524116	9	Time out error of CAN-Transmit-Frame SCR2
1661	524116	9	Time out error of CAN-Transmit-Frame SCR2
1662	524117	9	Time out error of CAN-Transmit-Frame SCR3
1662	524117	9	Time out error of CAN-Transmit-Frame SCR3
1663	524097	9	Time out error of CAN-Transmit-Frame DPFBrnAirPmpCtl
1663	524097	9	Time out error of CAN-Transmit-Frame DPFBrnAirPmpCtl
1664	524098	9	Time out error of CAN-Transmit-Frame ComDPFBrnPT
1664	524098	9	Time out error of CAN-Transmit-Frame ComDPFBrnPT
1665	524099	9	Time out error of CAN-Transmit-Frame ComDPFCl
1665	524099	9	Time out error of CAN-Transmit-Frame ComDPFCl
1666	524100	9	Time out error of CAN-Transmit-Frame ComDPFHisDat
1666	524100	9	Time out error of CAN-Transmit-Frame ComDPFHisDat
1667	524101	9	Time out error of CAN-Transmit-Frame ComDPFTstMon
1667	524101	9	Time out error of CAN-Transmit-Frame ComDPFTstMon
1668	524105	9	Time out error of CAN-Transmit-Frame ComEGRMsFlw
1668	524105	9	Time out error of CAN-Transmit-Frame ComEGRMsF Iw
1669	524108	9	Time out error of CAN-Transmit-Frame ComEGRTVActr
1669	524108	9	Time out error of CAN-Transmit-Frame ComEGRTVActr
1670	524110	9	Time out error of CAN-Transmit-Frame ComETVActr
1670	524110	9	Time out error of CAN-Transmit-Frame ComETVActr
1671	524112	9	Time out ComlTVActr
1671	524112	9	Time out ComlTVActr
1672	524118	9	Time out error of CAN-Receive-Frame ComRxCMl

Fault Codes	SPN Codes	FMI Codes	Deutz Description
1672	524118	9	Time out error of CAN-Receive-Frame ComRxCMI
1673	524119	9	Time out error of CAN-Receive-Frame ComRxCustSCR3
1673	524119	9	Time out error of CAN-Receive-Frame ComRxCustSCR3
1674	524102	9	Time out error of CAN-Receive-Frame ComRxDPFBrnAirPmpCtl
1674	524102	9	Time out error of CAN-Receive-Frame ComRxDPFBrnAirPmpCtl
1675	524103	9	Time out error of CAN-Receive-Frame ComRxDPFBrnAirPmp
1675	524103	9	Time out error of CAN-Receive-Frame ComRxDPFBrnAirPmp
1676	524104	9	Time out error of CAN-Receive-Frame ComRxDPFCtl
1676	524104	9	Time out error of CAN-Receive-Frame ComRxDPFCtl
1677	524106	9	Time out error of CAN-Receive-Frame ComRxEGRMsFlwl
1677	524106	9	Time out error of CAN-Receive-Frame ComRxEGRMsFlwl
1678	524107	9	Time out error of CAN-Receive-Frame ComRxEGRMsFlw2
1678	524107	9	Time out error of CAN-Receive-Frame ComRxEGRMsFlw2
1679	524109	9	Time out error of CAN-Receive-Frame ComRxEGRTVActr
1679	524109	9	Time out error of CAN-Receive-Frame ComRxEGRTVActr
1680	524111	9	Time out error of CAN-Receive-Frame ComRxETVActr
1680	524111	9	Time out error of CAN-Receive-Frame ComRxETVActr
1681	524113	9	Time out error of CAN-Receive-Frame ComRxlTVActr
1681	524113	9	Time out error of CAN-Receive-Frame ComRxlTVActr
1682	524120	9	Time out error of CAN-Receive-Frame ComRxSCRHtDiag
1682	524120	9	Time out error of CAN-Receive-Frame ComRxSCRHtDiag
1683	524121	9	Time out error of CAN-Receive-Frame ComRxTrbChActr
1683	524121	9	Time out error of CAN-Receive-Frame ComRxTrbChActr
1684	524122	9	Time out error of CAN-Receive-Frame ComRxUQSens
1684	524122	9	Time out error of CAN-Receive-Frame ComRxUQSens
1685	524123	9	Time out error of CAN-Receive-Frame ComSCRHtCtl
1685	524123	9	Time out error of CAN-Receive-Frame ComSCRHtCt
1686	524124	9	Time out error of CAN-Receive-Frame ComTxATIlMG
1686	524124	9	Time out error of CAN-Receive-Frame ComTxATIlMG
1687	524125	9	Time out error of CAN-Receive-Frame ComTxTrbChActr
1687	524125	9	Time out error of CAN-Receive-Frame ComTxTrbChActr
14S1	524025	5	DPF system; operating voltage error
14S2	524044	9	CAN message ComMS_Sys7 not received from slave
14S3	523632	2	Metering control is not performed in time error
I486	523718	5	SCR main relay; open load (only CV56B)

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